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PLEASURES OF THE TELESCOPE.

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II.—IN THE STARRY HEAVENS.

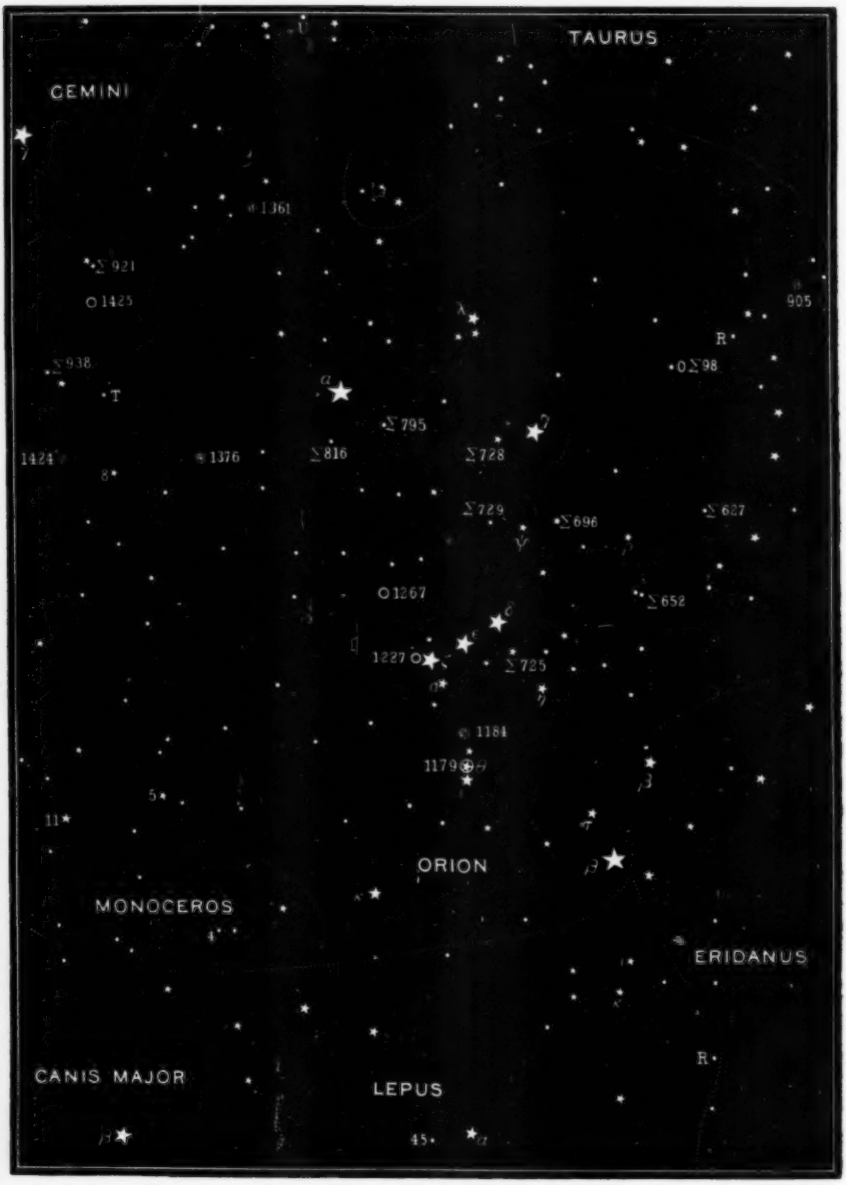
LET us imagine ourselves the happy possessors of three properly mounted telescopes of five, four, and three inches aperture, respectively. A fine midwinter evening has come along, the air is clear, cool, and steady, and the heavens, of that almost invisible violet which is reserved for the lovers of celestial scenery, are spangled with stars that hardly twinkle. We need not disturb our minds about a few thin clouds here and there floating lazily in the high air; they announce a change of weather, but they will not trouble us to-night.

Which way shall we turn? Our eyes will answer the question for us. However we may direct them, they instinctively return to the south, and are lifted to behold Orion in his glory, now near the meridian and midway to the zenith, with Taurus shaking the glittering Pleiades before him, and Canis Major with the flaming Dog Star following at his heels.

Not only is Orion the most brilliant of all constellations to the casual star-gazer, but it contains the richest mines that the delver for telescopic treasures can anywhere discover. We could not have made a better beginning, for here within a space of a few square degrees we have a wonderful variety of double stars and multiple stars, so close and delicate as to test the powers of the best telescopes, besides a profusion of star-clusters and nebulæ, including one of the supreme marvels of space, the Great Nebula in the Sword.

Our star map No. 1 will serve as a guide to the objects which

we are about to inspect. Let us begin operations with our smallest telescope, the three-inch. I may remark here that, just as the lowest magnifying power that will clearly reveal the object looked



Map No. 1.

for gives ordinarily better results than a higher power, so the smallest telescope that is competent to show what one wishes to see is likely to yield more satisfaction, as far as that particular

object is concerned, than a larger glass. The larger the object glass and the higher the power, the greater are the atmospheric difficulties. A small telescope will perform very well on a night when a large one is helpless.

Turn the glass upon β (Rigel), the white first-magnitude star in Orion's left foot. Observe whether the image with a high power is clear, sharp, and free from irregular wisps of stray light. Look at the rings in and out of focus, and if you are satisfied with the performance, try for the companion. A good three-inch is certain to show it, except in a bad state of the atmosphere, and even then an expert can see it, at least by glimpses. The companion is of the ninth magnitude, some say the eighth, and the distance is about 9·5″, angle of position (hereafter designated by p.) 199°.* Its color is blue, in decided contrast with the white light of its great primary. Sir John Herschel, however, saw the companion red, as others have done. These differences are doubtless due to imperfections of the eye or the telescope. In 1871 Burnham believed he had discovered that the companion was an exceedingly close double star. No one except Burnham himself ever succeeded in dividing it, and he could only do so at times. Afterward, when he was at Mount Hamilton, he tried in vain to split it with the great thirty-six-inch telescope, in 1889, 1890, and 1891. His want of success induced him to suggest that the component stars were in rapid motion, and so, although he admitted that it might not be double after all, he advised that it should be watched for a few years longer.

Rigel has been suspected of a slight degree of variability. It is evidently a star of enormous actual magnitude, for its parallax escapes trustworthy measurement. It can only be ranked among the very first of the light-givers of the visible universe. Spectroscopically it belongs to a peculiar type which has very few representatives among the bright stars, and which has been thus described: "Spectra in which the hydrogen lines and the few metallic lines all appear to be of equal breadth and sharp definition." Rigel shows a line believed to represent magnesium; but while it has iron lines in its spectrum, it exhibits no evidence of the exist-

* The angle of position measures the inclination to the meridian of a line drawn between the principal star and its companion; in other words, it shows in what direction from the primary we must look for the companion. It is reckoned from 0° up to 360°, beginning at the north point and passing around by east through south and west to north again. Thus, if the angle of position is 0° or 360°, the companion is on the north side of the primary; if the angle is 90°, the companion is to the east; if 180°, to the south; if 270°, to the west, and so for intermediate angles. It must be remembered, however, that in the field of the telescope the top is south and the bottom north, unless a prism is used, when directions become complicated. East and west can be readily identified by noticing the motion of a star through the field; it moves toward the west and from the east.

ence of any such cloud of volatilized iron as that which helps to envelop the sun.

For another test of what the three-inch will do turn to ζ, the lower, or left-hand, star in the Belt. This is a triple, the magnitudes being second, sixth, and tenth. The sixth-magnitude star is about 2·5″ from the primary, p. 149°, and has a very peculiar color, hard to describe. It requires careful focusing to get a satisfactory view of this star with a three-inch telescope. Use magnifying powers up to two hundred and fifty diameters. With our four-inch the star is much easier, and the five-inch shows it readily with a power of one hundred. The tenth-magnitude companion is distant 56″, p. 8°, and may be glimpsed with the three-inch. Upon the whole, we shall find that we get more pleasing views of ζ Orionis with the four-inch glass.

Just to the left of ζ, and in the same field of view with a very low power, is a remarkable nebula bearing the catalogue number 1227. We must use our five-inch on this with a low power, but with ζ out of the field in order to avoid its glare. The nebula is exceedingly faint, and we can be satisfied if we see it simply as a hazy spot, although with much larger telescopes it has appeared at least half a degree broad. Tempel saw several centers of condensation in it, and traced three or four broad nebulous streams, one of which decidedly suggested spiral motion.

The upper star in the Belt, δ, is double; distance, 53″, p. 360°; magnitudes, second and seventh very nearly; colors, white and green or blue. This, of course, is an easy object for the three-inch with a low magnifying power. It would be useless to look for the two fainter companions of δ, discovered by Burnham, even with our five-inch glass. But we shall probably need the five-inch for our next attempt, and it will be well to put on a high power, say three hundred diameters. The star to be examined is the little brilliant dangling below the right-hand end of the Belt, toward Rigel. It appears on the map as η. Spare no pains in getting an accurate focus, for here is something worth looking at, and unless you have a trained eye you will not easily see it. The star is double, magnitudes third and sixth, and the distance from center to center barely exceeds 1″, p. 87°. A little tremulousness of the atmosphere for a moment conceals the smaller star, although its presence is manifest from the peculiar jutting of light on one side of the image of the primary. But in an instant the disturbing undulations pass, the air steadies, the image shrinks and sharpens, and two points of piercing brightness, almost touching one another, dart into sight, the more brilliant one being surrounded by an evanescent circle, a tiny ripple of light, which, as it runs round the star and then recedes, alternately embraces and releases the smaller companion. The wash

of the light-waves in the atmosphere provokes many expressions of impatience from the astronomer, but it is often a beautiful phenomenon nevertheless.

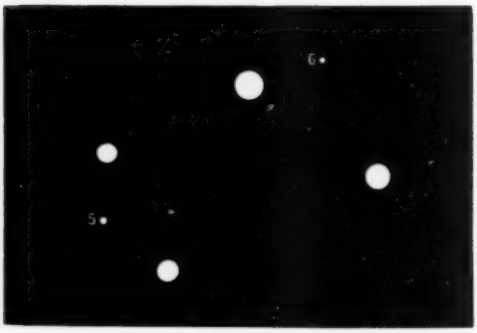
Between η and δ is a fifth-magnitude double star, Σ 725, which is worth a moment's attention. The primary, of a reddish color, has a very faint star, eleventh magnitude, at a distance of 12·7″, p. 88°.

Still retaining the five-inch in use, we may next turn to the other end of the Belt, where, just under ζ, we perceive the fourth-magnitude star σ. He must be a person of indifferent mind who, after looking with unassisted eyes at the modest glimmering of this little star, can see it as the telescope reveals it without a thrill of wonder and a cry of pleasure. The glass, as by a touch of magic, changes it from one into eight or ten stars. There are two quadruple sets three and a half minutes of arc apart. The first set exhibits a variety of beautiful colors. The largest star, of fourth magnitude, is pale gray; the second in rank, seventh magnitude, distance 42″, p. 61°, presents a singular red, "grape-red" Webb calls it; the third, eighth magnitude, distance 12″, p. 84°, is blue; and the fourth, eleventh magnitude, distance 12″, p. 236°, is apparently white. Burnham has doubled the fourth-magnitude star, distance 0·23″. The second group of four stars consists of three of the eighth to ninth magnitude, arranged in a minute triangle with a much fainter star near them. Between the two quadruple sets careful gazing reveals two other very faint stars. While the five-inch gives a more satisfactory view of this wonderful multiple star than any smaller telescope can do, the four-inch and even the three-inch would have shown it to us as a very beautiful object. However we look at them, there is an appearance of association among these stars, shining with their contrasted colors and their various degrees of brilliance, which is significant of the diversity of conditions and circumstances under which the suns and worlds beyond the solar system exist.

From σ let us drop down to see the wonders of Orion's Sword displayed just beneath. We can use with advantage any one of our three telescopes; but since we are going to look at a nebula, it is fortunate that we have a glass so large as five inches aperture. It will reveal interesting things that escape the smaller instruments, because it grasps more than one and a half times as much light as the four-inch, and nearly three times as much as the three-inch; and in dealing with nebulæ a plenty of light is the chief thing to be desired. The middle star in the Sword is θ, and it is surrounded by the celebrated Nebula of Orion. The telescope shows θ separated into four stars arranged at the corners of an irregular square, and shining in a black gap in the

nebula. These four stars are collectively named the Trapezium. The brightest is of the sixth magnitude, the others are of the seventh, seven and a half, and eighth magnitudes respectively. The radiant mist about them has a faint greenish tinge, while the four stars, together with three others at no great distance, which follow a fold of the nebula like a row of buttons on a coat, always appear to me to show an extraordinary liveliness of radiance, as if the strange haze served to set them off.

Our three-inch would have shown the four stars of the Trapezium perfectly well, and the four-inch would have revealed a fifth star, very faint, outside a line joining the smallest of the four and its nearest neighbor. But the five-inch goes a step farther and enables us, with steady gazing, to see even a sixth star, of only the twelfth magnitude, just outside the Trapezium, near the brightest member of the quartet. The Lick telescope has disclosed one or two other minute points of light associated with the Trapezium. But more interesting than the Trapezium is the vast cloud, full of strange shapes, surrounding it. Nowhere else in the heavens is the architecture of a nebula so clearly displayed. It is an unfinished temple whose gigantic dimensions, while exalting the imagination, proclaim the omnipotence of its builder. But though unfinished it is not abandoned. The work of creation is proceeding within its precincts. There are stars apparently completed, shining like gems just dropped from the hand of the polisher, and around them are masses, eddies, currents, and swirls of nebulous matter yet to be condensed, compacted, and constructed into suns. It is an education in the nebular theory of the universe merely to look at this spot with a good telescope. If we do not gaze at it long and wistfully, and return to it many times with unflagging interest, we may be certain that there is not the making of an astronomer in us.



THE TRAPEZIUM WITH THE FIFTH AND SIXTH STARS.

Before quitting the Orion nebula do not fail to notice an eighth-magnitude star, a short distance northeast of the Great Nebula, and nearly opposite the broad opening in the latter that leads in toward the gap occupied by the Trapezium. This star is plainly enveloped in nebulosity, that is unquestionably connected with the larger mass of which it appears to form a satellite.

At the lower end of the Sword is the star ι, somewhat under the third magnitude. Our three-inch will show that it has a bluish companion of seventh or eighth magnitude, at a little more than 11″ distance, p. 142°, and the larger apertures will reveal a third star, of tenth magnitude, and reddish in color, distant 49″, p. 103°. Close by ι we find the little double star Σ 747, whose components are of five and a half and six and a half magnitudes respectively, and separated 36″, p. 223°. Above the uppermost star in the Sword is a small star cluster, No. 1184, which derives a special interest from the fact that it incloses a delicate double star, Σ 750, whose larger component is of the sixth magnitude, while the smaller is of the ninth, and the distance is only 4·3″, p. 59°. We may try the four-inch on this object.

Having looked at α (Betelgeuse), the great topaz star on Orion's right shoulder, and admired the splendor of its color, we may turn the four-inch upon the star Σ 795, frequently referred to by its number as "52 Orionis." It consists of one star of the sixth and another of sixth and a half magnitude, only 1·5″ apart, p. 200°. Having separated them with a power of two hundred and fifty diameters on the four-inch, we may try them with a high power on the three-inch. We shall only succeed this time if our glass is of first-rate quality and the air is perfectly steady.

The star λ in Orion's head presents an easy conquest for the three-inch, as it consists of a light-yellow star of magnitude three and a half and a reddish companion of the sixth magnitude; distance 4″, p. 43°. There is also a twelfth-magnitude star at 27″, p. 183°, and a tenth or eleventh magnitude one at 149″, p. 278°. These are tests for the five-inch, and we must not be disappointed if we do not succeed in seeing the smaller one even with that aperture.

Other objects in Orion, to be found with the aid of our map, are: Σ 627, a double star, magnitude six and a half and seven, distance 21″, p. 260°. O Σ 98, otherwise named *i* Orionis, double, magnitude six and seven, distance 1″, p. 218°, requires five-inch glass; Σ 652, double magnitudes six and a half and eight, distance 1·7″, p. 184°; ρ, double, magnitudes five and eight and a half, the latter blue, distance 7″, p. 62°, may be tried with a three-inch; τ, triple star, magnitudes four, ten and a half, and eleven, distances 36″, p. 249°, and 36″, p. 60°. Burnham discovered that the ten-and-a-half magnitude star is again double, distance 4″, p. 50°. There is not much satisfaction in attempting τ Orionis with telescopes of ordinary apertures; Σ 629, otherwise *m* Orionis, double, magnitudes five and a half (greenish) and seven, distance 31·7″, p. 28°, a pretty object; Σ 728, otherwise A 32, double, magnitudes five and seven, distance 0·5″ or less, p. 206°, a rapid binary, which is at

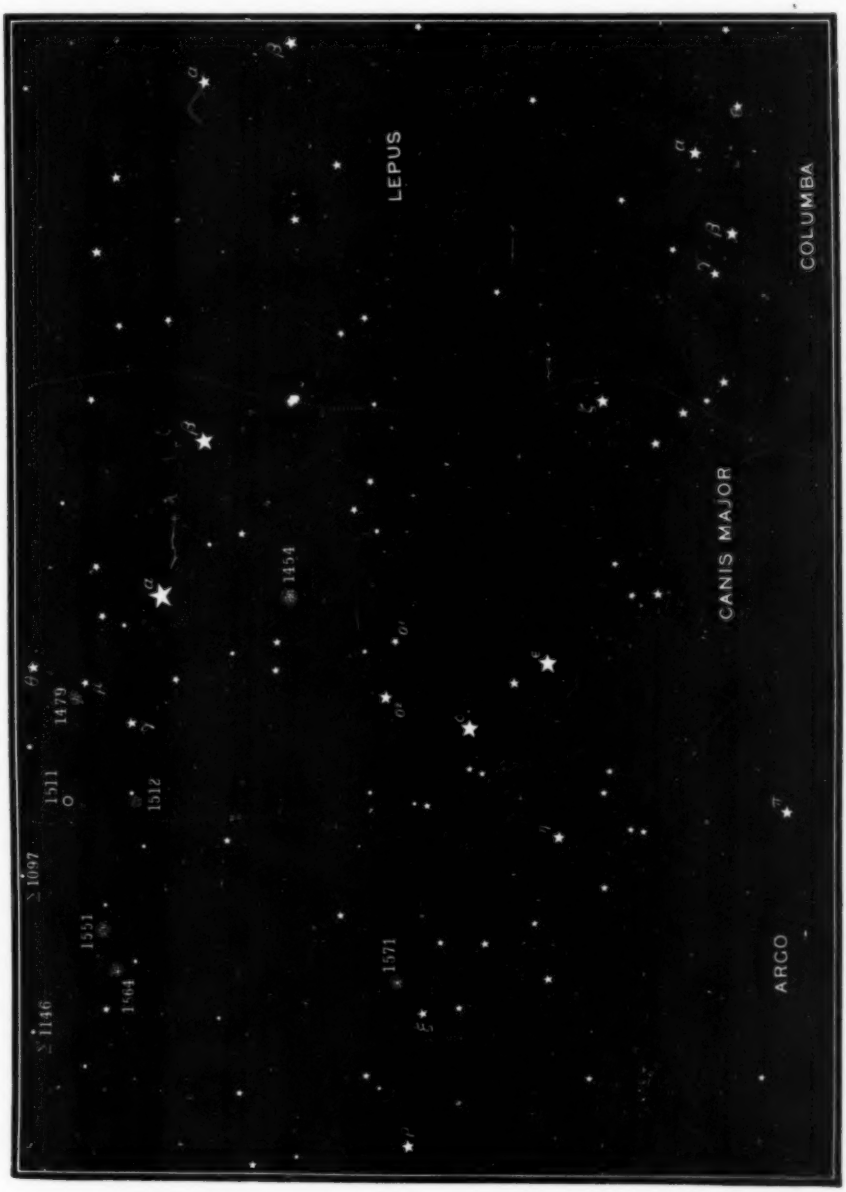
present too close for ordinary telescopes, although it was once within their reach; Σ 729, double, magnitudes six and eight, distance 2″, p. 26°, the smaller star pale blue. Try it with a four-inch, but five-inch is better; Σ 816, double, magnitudes six and half and eight and a half, distance 4″, p. 289°; ψ 2, double, magnitudes five and a half and eleven, distance 3″, or a little less, p. 322°; 905, star cluster, contains about twenty stars from eighth to eleventh magnitude; 1267, nebula, faint, containing a triple star of eighth magnitude, two of whose components are 51″ apart, while the third is only 1·7″ from its companion, p. 85°; 1376, star cluster, small and crowded; 1361, star cluster, triangular shape, containing thirty stars, seventh to tenth magnitudes, one of which is a double, distance 2·4″.

Let us now leave the inviting star-fields of Orion and take a glance at the little constellation of Lepus, crouching at the feet of the mythical giant. We may begin with a new kind of object, the celebrated red variable R Leporis (map No. 1). This star varies from the sixth or seventh magnitude to magnitude eight and a half in a period of four hundred and twenty-four days. Hind's picturesque description of its color has frequently been quoted. He said it is "of the most intense crimson, resembling a blood-drop on the black ground of the sky." It is important to remember that this star is reddest when faintest, so that if we chance to see it near its maximum of brightness it will not impress us as being crimson at all, but rather a dull, coppery red. Its spectrum indicates that it is smothered with absorbing vapors, a sun near extinction which, at intervals, experiences an accession of energy and bursts through its stifling envelope with explosive radiance, only to faint and sink once more. It is well to use our largest aperture in examining this star.

We may also employ the five-inch for an inspection of the double star ι, whose chief component of the fifth magnitude is beautifully tinged with green. The smaller companion is very faint, eleventh magnitude, and the distance is about 13″, p. 337°.

Another fine double in Lepus is κ, to be found just below ι; the components are of fifth and eighth magnitudes, pale yellow and blue respectively, distance 2·5″, p. 360°; the third-magnitude star α has a tenth-magnitude companion at a distance of 35″, p. 156°, and its neighbor β (map No. 2), according to Burnham, is attended by three eleventh-magnitude stars, two of which are at distances of 206″, p. 75°, and 240″, p. 58°, respectively, while the third is less than 3″ from β, p. 288°; the star γ (map No. 2) is a wide double, the distance being 94″, and the magnitudes fourth and eighth. The star numbered 45 is a remarkable multiple, but the components are too faint to possess much interest for those who are not armed with very powerful telescopes.

From Lepus we pass to Canis Major (map No. 2). There is no hope of our being able to see the companion of α (Sirius), at present (1894), even with our five-inch. Discovered by Alvan Clark with



Map No. 2.

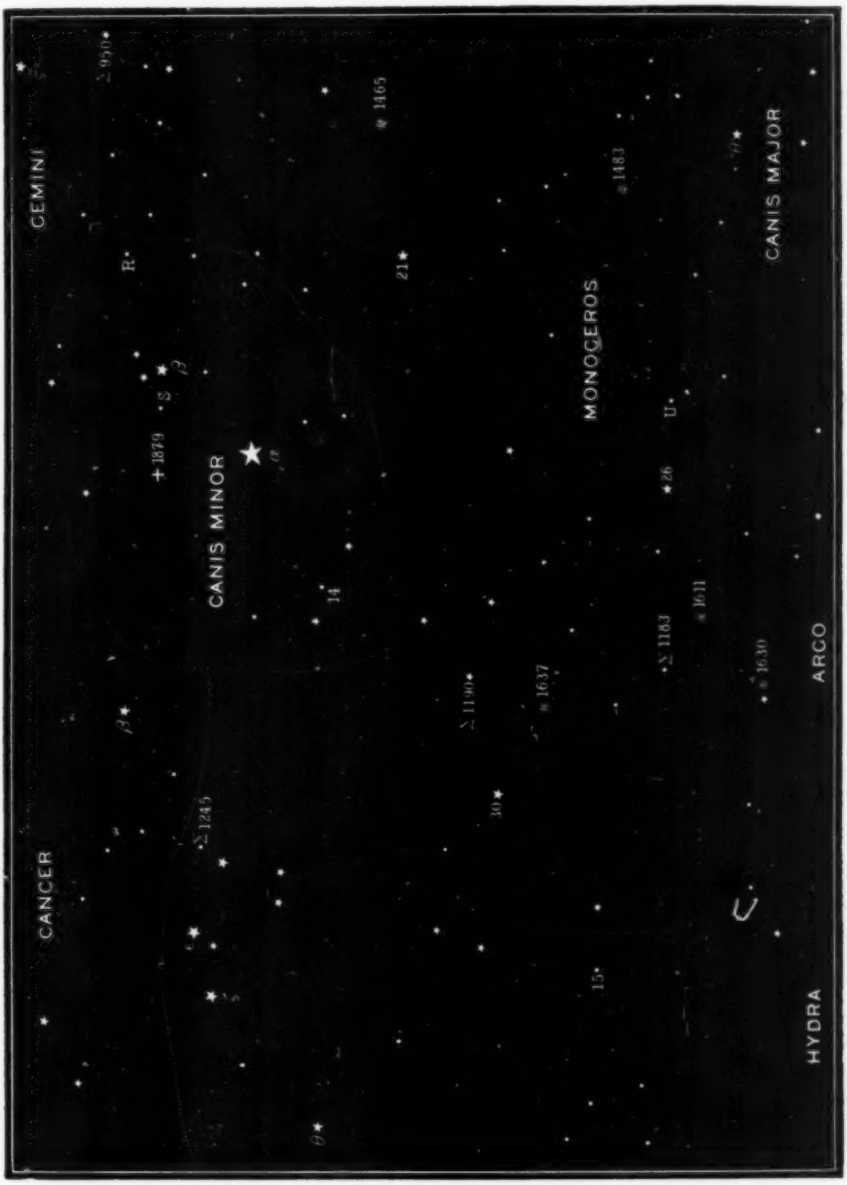
an eighteen-inch telescope in 1862, when its distance was 10″ from the center of Sirius, this ninth-magnitude star has since been swallowed up in the blaze of its great primary. It at first slightly increased its distance, and from 1868 until 1879 most of the meas-

ures made by different observers considerably exceeded 11″. Then it began to close in, and in 1890 the distance scarcely exceeded 4″. Burnham was the last to catch sight of it with the Lick telescope in that year. Since then no human eye has seen it. But during its visibility its motions were so carefully studied that we can have no doubt of its ultimate reappearance as it continues to pursue its orbit around the center of gravity between it and Sirius. According to Burnham, its periodic time is about fifty-three years, and its nearest approach to Sirius should have taken place in the middle of 1892. In that case it is now rapidly receding from periastron, and news of its emergence from the rays of Sirius should be expected at any time from Mount Hamilton, where a vigilant outlook is maintained. If we can not see the companion of the Dog Star with our instruments, we can at least, while admiring the splendor of that dazzling orb, reflect with profit upon the fact that although the companion is ten thousand times less bright than Sirius, it is fully half as massive as its brilliant neighbor. Imagine a subluminous body half as ponderous as the sun to be set revolving around it somewhere between Uranus and Neptune. Remember that that body would possess one hundred and sixty-five thousand times the gravitating energy of the earth, and that five hundred and twenty Jupiters would be required to equal its power of attraction, and then consider the consequences to our easy-going planets! Plainly the solar system is not cut according to the Sirian fashion. We shall hardly find a more remarkable coupling of celestial bodies until we come, on another evening, to a star that began, ages ago, to amaze the thoughtful and inspire the superstitious with dread—the wonderful Algol in Perseus.

We may remark in passing that Sirius is the brightest representative of the great spectroscopic type I, which includes more than half of all the stars yet studied, and which is characterized by a white or bluish-white color, and a spectrum possessing few or at best faint metallic lines, but remarkably broad, black, and intense lines of hydrogen. The inference is that Sirius is surrounded by an enormous atmosphere of hydrogen, and that the intensity of its radiation is greater, surface for surface, than that of the sun. There is historical evidence to support the assertion, improbable in itself, that Sirius, within eighteen hundred years, has changed color from red to white.

With either of our telescopes we shall have a feast for the eye when we turn the glass upon the star cluster No. 1454, some four degrees south of Sirius. Look for a red star near the center. Observe the curving rows so suggestive of design, or rather of the process by which this cluster was evolved out of a pre-existing nebula. You will recall the winding streams in the Great Nebula

of Orion. Another star cluster worth a moment's attention is No. 1479, above and to the left of Sirius. We had better use the five-inch for this, as many of the stars are very faint. Not far away



Map No. 8.

we find the double star μ, whose components are of the fifth and eighth magnitude, distance 2·8″, p. 343°. The small star is pale blue. Cluster No. 1512 is a pleasing object with our largest aperture. In No. 1511 we have a faint nebula remarkable for the rows

of minute stars in and near it. The star γ is an irregular variable. In 1670 it is said to have almost disappeared, while at the beginning of the eighteenth century it was more than twice as bright as it is to-day. The reddish star δ is also probably variable. In my Astronomy with an Opera Glass will be found a cut showing a singular array of small stars partly encircling δ. These will be widely scattered, even with the lowest power of a telescope.

Eastward from Canis Major we find some of the stars of Argo Navis. Σ 1097, of sixth magnitude, has two minute companions at 20″ distance, p. 311° and 312°. The large star is itself double, but the distance 0·8″, p. 166°, places it beyond our reach. According to Burnham, there is yet a fourth faint star at 31″, p. 40°. Some three degrees and a half below and to the left of the star just examined is a beautiful star cluster, No. 1551. Nos. 1564, 1571, and 1630 are other star clusters well worth examination. A planetary nebula is included in 1564. With very powerful telescopes this nebula has been seen ring-shaped. Σ 1146, otherwise known as 5 Navis, is a pretty double, colors pale yellow and blue, magnitudes fifth and seventh, distance 3·25″, p. 19°. Our three-inch will suffice for this.

North of Canis Major and Argo we find Monoceros and Canis Minor (map No. 3). The stars forming the western end of Monoceros are depicted on map No. 1. We shall begin with these. The most interesting and beautiful is 11, a fine triple star, magnitudes fifth, sixth, and seventh, distances 7·4″, p. 131°, and 2·7″, p. 103°. Sir William Herschel regarded this as one of the most beautiful sights in the heavens. It is a good object to try our three-inch on, although it should not be difficult for such an aperture. The star 4 is also a triple, magnitudes sixth, tenth, and eleventh, distances 3·4″, p. 178°, and 10″, p. 244. We should glance at the star 5 to admire its fine orange color. In 8 we find a golden fifth-magnitude star, combined with a blue or lilac star of the seventh magnitude, distance 13″, p. 24°. Σ 938 is a difficult double, magnitudes six and a half and twelve, distance 10″, p. 210°. Σ 921 is double, magnitudes six and a half and eight, distance 16″, p. 4°. At the spot marked on the map 1424 we find an interesting cluster containing one star of the sixth magnitude.

The remaining stars of Monoceros will be found on map No. 3. The double and triple stars to be noted are S, or Σ 950 (which is also a variable and involved in a faint nebula), magnitudes sixth and ninth, distance 2·5″, p. 206°; Σ 1183, double, magnitudes five and a half and eight, distance 31″, p. 326°; Σ 1190, triple. magnitudes five and a half, tenth, and ninth, distances 31″, p. 105, and 67″, p. 244. The clusters are 1465, which has a minute triple star near the center; 1483, one member of whose swarm is red; 1611, very small but rich; and 1637, interesting for the great number

of ninth-magnitude stars that it contains. We should use the five-inch for all of these.

Canis Minor and the Head of Hydra are also contained on map No. 3. Procyon, α of Canis Minor, has several minute stars in the same field of view. There is, besides, an invisible companion which no telescope has yet revealed, but which must be of immense mass, since its attraction causes perceptible perturbations in the motion of Procyon. One of the small stars just referred to, the second one east of Procyon, distant one third of the moon's diameter, is an interesting double. Our four-inch may separate it, and the five-inch is certain to do so. The magnitudes are seventh and seven and a half or eighth, distance 1·2″, p. 133°. This star is variously named Σ 1126 and 31 Can. Min. Bode. Star No. 14 is a wide triple, magnitudes sixth, seventh, and eighth, distances 75″, p. 65°, and 115″, p. 154°.

PROCYON AND ITS NEIGHBORS.

In the Head of Hydra we find Σ 1245, a double of sixth and seventh magnitudes, distance 10·5″, p. 25. The larger star shows a fine yellow. In ε we have a beautiful combination of a yellow with a blue star, magnitudes fourth and eighth, distance 3·4″, p. 198°. Finally, let us look at θ for a light test with the five-inch. The two stars composing it are of the fourth and twelfth magnitudes, distance 50″, p. 170°.

The brilliant constellations of Gemini and Taurus tempt us next, but warning clouds are gathering, and we shall do well to house our telescopes and warm our fingers by the winter fire. There will be other bright nights, and the stars are lasting.

BUCKLAND, when traveling, could never pass a quarry without stopping and examining it. On one journey the mare he rode "soon learned her duty, and seemed to take an interest in her master's pursuits; for she would remain quiet, without any one to hold her, while he was examining sections and strata, and then patiently submit to be loaded with the specimens collected. Ultimately she became so accustomed to the work that she invariably came to a full stop at a stone quarry, and nothing would persuade her to proceed until the rider had got off and examined, or, if a stranger to her, pretended to examine, the quarry."

TWENTY-FIVE YEARS OF PREVENTIVE MEDICINE.

By Mrs. H. M. PLUNKETT.

"Who would not give a trifle to *prevent*
What he would give a thousand worlds to cure?"

IN 1849 the Legislature of Massachusetts appropriated five hundred dollars to be expended in a preliminary investigation of the question whether any attempt at sanitation was worth while; and in the year 1893 she expended $62,876.82, under the supervision of her State Board of Health, much of which went to accomplished biological and chemical experts, to learn exactly on what a pure water supply depends. The previous work of the board in this field had been so well done that Prof. Henry Robinson, of England, in a paper read before the Congress of Hygiene and Demography, in London, in 1891, said: "The action that has been taken by the State Board of Health of Massachusetts, to protect the purity of inland waters, deserves to be specially commended as an example of broad and wise policy, in instituting the systematic investigation by engineers, chemists, and biologists of all that bears upon the purification of sewage and on the filtration of water. . . . The exhaustive reports under these different heads may be stated to be far in advance of anything that has been fairly attempted in this country." No better picture of the difference in public opinion at the two dates could be found than those two contrasting amounts of money. At the first, the apathy and indifference born of ignorance reigned; at the second, we behold the immense amount of intelligent effort constantly being put forth in this country as the fruit of a quarter of a century of sanitary education.

If a man is going to give a true history of an apple tree, it will not do to begin when the tiny shoot pushes itself up through the mold; he needs to give an account of the seed itself, how produced, when planted, and of the influences that produced its germination. The seed from which the vast mass of public-health legislation and action among English-speaking peoples has sprung, was planted in England by Edwin Chadwick, between the years 1830 and 1844, when his epoch-making Report on the Health of Towns was made to Parliament. Various commissions, with him at their head, had investigated the great mortality among the troops; had looked into the condition of the children employed in factories, mines, and collieries; had studied the terrible, always-prevailing typhus; but this tremendous array of facts, culminating in the statement that the average length of human life in agricultural Wiltshire was thirty-five years, and in Liverpool

only fifteen years, roused the whole nation to ask, "Why?" and "Can nothing be done to remedy it?" Chadwick was a barrister of the Inner Temple when, in 1828, a trifling incident turned his attention from the law to the subject of vital statistics, of which few worthy of the name were in existence. An able article from his pen, on What might be done to Improve the Taking of Vital Statistics, at once drew the attention of the country to him, and pointed him out as a man of unique sagacity in "extracting from masses of details the master facts, and bringing these to bear for the elucidation of a master thought." Parliament at once made use of his remarkable abilities, and, beginning with finding out the worst that could be known, inaugurated measures, largely under his guidance, for the amelioration of evils, till to-day, they and we, live in a different world. Most worthily was he knighted by the Queen, and when he died was universally recognized as the father of sanitation. One of his earliest measures was the framing of an act to procure an accurate registration of births, marriages, and deaths; and Sir John Simon says: "Before that time a perfect chaos respecting the population and mortality reigned. Since that time a mass of statistics relative to life, health, and disease has been accumulating which will exert, and is exerting, an immensely beneficial influence upon the physical and moral welfare of these realms (England and Wales), and indeed, ultimately, on every people on the face of the globe. The discoveries in astronomy have not a more palpable application to navigation and commerce, or the investigations of chemistry to manufactures, than have the statistics of health and disease to moral regeneration." But it was Chadwick's report of 1844 that waked up a slumbering nation. Fifty years after, the death rate in the whole country had been cut down from thirty-two to eighteen in the thousand. The work going on there did not escape the eyes of progressive men here. Another layman, Lemuel Shattuck, of Boston, watched the matter in its every step of development, and being touched with the same fine "enthusiasm for humanity" as Chadwick, by voice and pen strove to kindle an answering flame at home. Largely through his influence, the Legislature of Massachusetts passed an act in 1849 by which the Governor was to appoint three commissioners who were to report and prepare a plan for a sanitary survey of the State, etc. They were to be paid, for the time actually spent in the discharge of their duty, the same compensation as members of the General Court, and for travel, and could spend fifty dollars for books, which were to belong to the State Library when they were done with them, but on no account were the expenses of the commission to exceed five hundred dollars!

The Governor appointed Lemuel Shattuck, N. P. Banks, and

Jehiel Abbott as commissioners, and Mr. Shattuck formulated their conclusions in a report that to-day is one of the most interesting and instructive of sanitary documents. Sanitary science, as we now know it, had not come into being then, so that to write about it as an existent fact was considerably like "coining a vacuum"; but Mr. Shattuck condensed into it all that history can teach on hygiene from Moses down, and, as he was keenly alive to all that was going on in England, he did not fail to call attention to the great awakening on the subject there, where already two sanitary journals were established, and public meetings were being held in all parts of the country, where it was declared that "sanitation is the great idea of the age." Every consideration which it was thought could influence the legislative mind was brought to bear. The commission called attention to the fact that there had already been costly and valuable reports made on insects; the invertebrates; on fishes, reptiles, and birds; and one on trees and shrubs; and they say it would be reasonable to suppose that *man* was entitled to a consideration equal to either of these subjects. They cite the fact that two costly expeditions had been fitted out to search for Sir John Franklin, and ask if the preservation of the lives of many possible Franklins is not as worthy an object. They maintain that the average of human life may be much extended, its physical power augmented, . . . untimely deaths prevented, and that measures for *prevention* will effect infinitely more than remedies for the cure of disease. They compute the needless loss of life and the cost of avoidable sickness. They appeal to intelligent men of all classes, medical and non-medical, and quote from Simon's Report on the Condition of London: "Ignorant men may sneer at the pretensions of sanitary science. Weak and timorous men may hesitate to commit themselves to its principles, so large is their application. Selfish men may shrink from the labor of change, wicked men may turn indifferently from considering that which concerns the health and happiness of millions of their fellow-creatures, but in the great objects which it proposes to itself it transcends in importance all other sciences, and in its beneficent operation it seems to embody the spirit and to fulfill the intentions of practical Christianity." They brought the argument home, by demonstrating that at least $7,500,000 were lost annually to Massachusetts through untimely deaths and needless sickness.

The Board of Health they recommended was to consist of two doctors, one lawyer, one chemist or naturalist, and two of other occupations; and an elaborate plan of action was drawn up, covering nearly every possible combination of circumstances that such a board would be likely to encounter. Dr. Bowditch

said, twenty-seven years after, "This magnificent report fell flat from the printer's hands, but when in 1869 the State Board was established it was on the lines Mr. Shattuck had drawn." He did not live to see it carried into effect, but while he lived he never ceased to strive to bring the people of his State to correct views; and now that a great majority of the States have modeled their boards on that of Massachusetts, we can see that he did not labor in vain.

Meantime not all the rest of the country was asleep, for very earnest efforts were making in New York city looking toward the establishment of a central health authority. There was need enough of it, as these facts show: twenty thousand people were living in cellars; there were spots from which typhus was never absent; there were no less than three hundred and seventeen slaughterhouses with their inevitable fat-rendering and bone-boiling concomitants below Eightieth Street; and there is a credible witness now living who saw a small child killed in Madison Street, by one of the hogs which formerly ran loose in the city. It took fifteen years of effort, on the part of a set of men whose disinterested devotion to the best interests of humanity is beyond praise, before, in 1866, they secured a Board of Health for the city. Repeated decimating invasions of yellow fever had visited New Orleans, and in 1855 the Legislature of Louisiana passed a law for the establishment of quarantine, that involved the spending of much money; its authority was vested in a State Board of Health, and its powers were much enlarged in 1867. It was, no doubt, a valuable instrument with which to repel the invasion of exotic epidemics, but bore little resemblance to the thirty-seven State Boards of Health that have since come into being. The one was a frantic effort to repel an external enemy; the others direct their main efforts to the correction of internal sanitary sins of omission and commission. These, with their vigilant watchers in every hamlet, and their multipled publications of reports, pamphlets, directions, and leaflets—the true leaves that are for the healing of the nations—constitute a bureau of information that has saved thousands and thousands of lives. While Lemuel Shattuck's splendid programme of action was calmly slumbering in the State Library the war came, and all minor issues were swallowed up in the one "Shall we have a country left?" But even this had its compensations. Dr. H. I. Bowditch truly says, "Both North and South discovered the all-important advantages of cleanliness, sobriety, and strict methods of action, as opposed to the distress consequent on filth, intemperance, and chaotic rule." Dr. Bowditch himself, by the most persistent efforts, induced our military authorities to provide comfortable ambulances for the wounded, and from them has

come the present ambulance system of the world—for Europe copied us in this matter.

The putting to sleep of Lemuel Shattuck's noble report by apathetic legislators did not prevent progressive minds from pursuing the subject, and there was a knot of men in Boston who kept up interest in the work by stated meetings among themselves, and occasional public meetings, at one of which Edward Everett delivered one of his most brilliant addresses; but when they ascended Beacon Hill and took the practical steps of asking for the organization of a State Board of Health, it was sure to be defeated by the rural legislator from "way back," typified by the one who said, "Them boards don't do no good, and they cost a sight o' money." Just before the war the prospect became hopeful, and then came the imperative "Halt!" to all the lines of forward-marching progress. During the four long, bitter years of contest the whole land had taken a lesson in the value of organized action, and as soon as we had caught our breath the march was resumed with a quickened step. Meantime England had made great strides in practical sanitation, and it had begun to be stoutly held that some of the most destructive diseases are not the visitations of an angry God for the moral derelictions of people, but are the direct and palpable outcome of the neglect of sanitary laws. Especially was it believed in England that typhoid fever, the decimating scourge of young manhood and young womanhood, can be averted; and on this side the water Dr. Bowditch had instituted an inquiry looking to discovering the preventable causes of consumption. The results, printed only for private circulation, made a great impression in medical circles—for bacteriology with its tubercle bacillus had not been even heard of. The phrases Preventive or State medicine had begun to be used, when, in 1869, a remarkable concatenation of circumstances, consisting of two distinct lines of action, resulted in the establishment of the Massachusetts Board of Health. Repeated repulses at the State House had completely disheartened the advocates of State medicine in Boston, but unexpected help was coming to their aid from the extreme western part of the State. Those familiar with the annals of sanitation will recall a fearful visitation known as the *Maplewood Fever*, which occurred in the year 1864 in Pittsfield, at the Young Ladies' Institute, in which out of seventy-seven pupils fifty-one had typhoid fever of a virulent type, and thirteen died—as the result of purely local causes, the direct result of ignorant sanitary neglect. The outbreak occurred in August, and in September, at the instance of Thomas F. Plunkett (husband of the writer), three of the professors, who had come to give their annual courses of lectures in the Berkshire Medical College, undertook a

searching investigation. They were A. B. Palmer and C. L. Ford, of the University of Michigan, and Pliny Earle, Superintendent of the Northampton Insane Asylum, and after several months their fearless and exhaustive report was published in the Boston Medical and Surgical Journal and in pamphlet form. It created a profound sensation; but lest the proprietor of that school should be thought a "sinner above all others," it should be recalled that these were days prehistoric to sanitation, and that a bulky volume might be made up of the stories of epidemics caused by unsanitary conditions connected with schools and colleges. The man who had instigated the investigation was no enemy, but had been friend, trustee, and patron of the school from its foundation, but he was of the *fiat-justitia-ruat-cœlum* type, and the findings of the report, which proved that on those beautiful grounds, and only there, save in the case of day pupils who had been subjected to the same poison, was there any typhoid fever, sank deep into his heart. We quote one of the closing sentences: "To whatever extent the ignorance of sanitary laws may shield the violator from moral responsibility, it will not abate the physical penalty of such violation. This will fall with the same force upon the unconscious, the ignorant, the helpless, and morally innocent, as upon the intelligent, the powerful, and the wicked. . . . To prevent the poison of typhoid fever, when taken into the system, from producing its legitimate effects, except by natural agencies, would require as positive a miracle as to restore a severed head, or arrest the course of the heavenly bodies. Instead of closing our eyes and soothing our minds by casting the responsibility of a great calamity upon Providence, we should look to the physical conditions producing it, and see if these conditions are remediable." Some people thought these declarations of the preventability of disease by human agency bordered on the blasphemous, but the thought was "in the air." Dr. Budd, of Bristol, in England, had traced epidemics of typhoid directly to infected drinking water; and Dr. Austin Flint's classical study of the outbreak near Buffalo, N. Y., convinced medical men of its preventability, as well as here and there a progressive layman, but they all saw that only organized, concerted effort, fortified by law, could effect this exemption. Mr. Plunkett was chosen to the Legislature in 1868, and made some tentative efforts looking to a State Board, but the time was not auspicious. He was again a member in 1869, and in a faction fight in the dominant party had been able to render the candidate who was finally seated as Speaker an important service, and naturally the gentleman so seated was "willing to oblige," etc. Among the members were three physicians, and some other broad-minded progressive men; and rather late in the session, the motion was made to appoint a

committee to inquire into the expediency of establishing a Board of Health. The man who made the motion was placed at its head, and the kindly disposed Speaker desired him to name his associates; he designated those to whom the cause would appeal. Word was sent to Dr. Bowditch and his fellow-sanitarians to come and present their reasons. A bill was drawn, but its champion did not care to have it discussed till late in the session, when many of the timid obstructionists would have hied themselves to their rural farms; and when speaking in its advocacy, he ignored the wails of the bereaved fathers and mothers of the Maplewood pupils, and based his plea entirely on economic grounds, saying that by the aid of law preventable diseases might be checked; that it had been shown that typhoid fever was a preventable disease. He called attention to the fact that it generally attacked persons in the productive age, and that scarcely one of the three hundred and thirty-five towns in the State but had at least one annual victim. He said a man of twenty-one represented an investment of ten thousand dollars; that it had cost at least five hundred dollars each year of somebody's money—public or private—to feed, clothe, shelter, and educate him; and thus the State sustained an annual loss of five million three hundred and fifty thousand dollars.

It seems humiliating that the issues of life and death should be made to hinge on a pocket argument, but it was effective, and the law establishing a State Board of Health was enacted June 21, 1869. The members were to be appointed by the Governor and Council. The act was not twenty-four hours old before an application from an unprogressive doctor-constituent came to its champion for a position. The Governor said, "I suppose you have some friends you would like to see on the board?" "No," was the answer, "only I think it goes without saying who should be at its head—Dr. H. I. Bowditch, who has worked disinterestedly for so many years toward this consummation; for the rest, all I ask is that you will not make it worthless by appointing a set of nobodies, on account of their political opinions." The Governor rose to the occasion; the pace he set has never been lost, and in the twenty-five years of its existence many of the ablest men in the Commonwealth have lent their powers to make it a success. The action of the member from the "western county" may be compared to that of the man who turns the jet and applies the match, thus setting the already waiting illuminant alight—a small but very indispensable operation. There are now thirty-six State Boards patterned very closely after this, under whose guidance a whole army of sanitarians is at work.

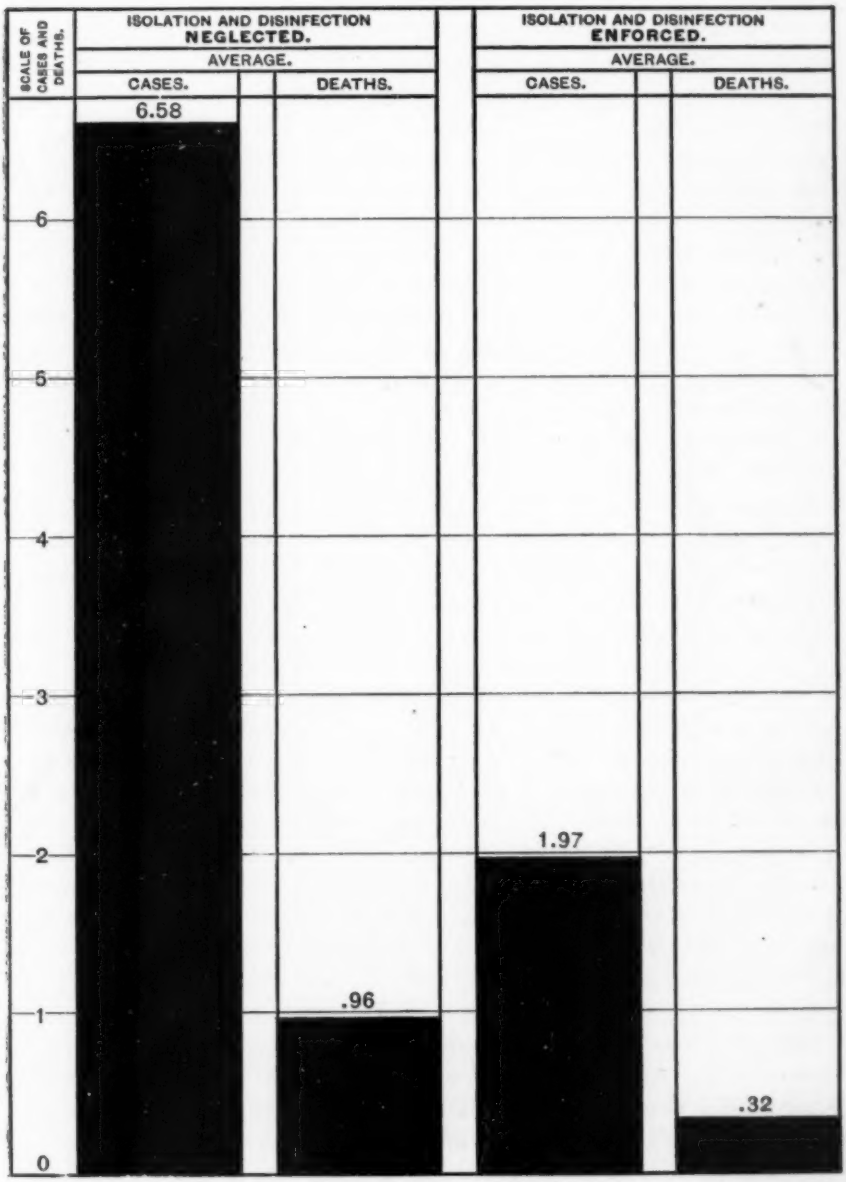
"Its banner bears the single line,
'Our duty is to save.'"

The board had to blaze out a new path into regions hitherto unoccupied. At its first meeting Dr. Bowditch said: "I know of no higher office in the State than that which we now hold, viz., that of inaugurating the idea of State medicine in Massachusetts. Upon our high or low appreciation of the position, and of the duties resulting from that position, and upon our wise or foolish performance of these duties, depends the success of the object aimed at. Our work is for the far future as well as for the present. . . . I wish to impress upon you the essential dignity of the offices we now hold, and that we should assume them with minds loyal to the truth. . . . State medicine ranks among the most important matters now discussed by the highest intellects and the humanest hearts in Great Britain. . . . The chief object of the physician is *to cure;* the far higher aim of State medicine is, by its thorough and scientific investigation of the hidden causes of diseases that are constantly at work in an ignorant and debased community, to *prevent* the very origination of such diseases." He quoted Simon's "platform," that the sole object of State medicine is "the improvement in human health, and the lengthening out of human life of each individual man and woman." He also cited Dr. Farr's: "The primary object of public medicine is to prevent disease, but it also surrounds the sick with conditions most favorable to recovery, and diminishes the death-roll of the people. But supposing every condition most favorable for the operation of State medicine, we should still see grave defects in many persons; shortcomings in others; in many, organic degeneracies; in many, criminal depravities. How, out of the existing seed, to raise races of men to divine perfection is the final problem of public medicine. Public hygiene is a want, as much as air and public roads and waters are public necessities, and as such, must be cared for and paid for by the community."

The high ideal was nobly lived up to, and in a sort of manifesto addressed to the Municipal Boards of Health, nominally existing in all the towns of the State, they say: "We believe that all citizens have an inherent right to the enjoyment of pure and uncontaminated air and water and soil; that this right should be regarded as belonging to the whole community; and that no one should be allowed to trespass upon it by his carelessness or his avarice, or even by his ignorance. . . . These propositions are recognized in existing statutes, but they are not enforced, and the reason of that is, that the public mind is not sufficiently aware of the dangerous elements around us, does not understand the connection between filth and disease, and is not convinced that undrained land is not wholesome to live upon." The board at once set about collecting the mortality statistics in the principal cities and towns of the State, and addressed themselves to investigating

the corruption of springs, wells, reservoirs, and aqueducts, the sale of dangerous drugs, the sale of "swill milk" and watered milk, the sale of unwholesome meat, the condition of tenement and lodging houses, but say that "local and private interests have, it is thought, often been strong enough to paralyze the action of local health authorities"—an opinion that was violently confirmed a few years after, when they found themselves involved in a lawsuit with a powerful firm who were corrupting the water supply of a town with offal. It rendered a report to the Legislature of 1870, when it had been at work only six months, and had little of achievement to relate; but in the lofty ideals it holds up, and its catalogue of reasonable hopes for the future, though only a pamphlet of fifty-eight pages, it remains to this day a good sanitary bible for the earnest disciple. It would be amusing if it were not painful to see how gingerly it walked, claiming only "advisory" powers, it was by no means firm in the saddle and dreaded lest some "watchdog of the treasury" should land it on the ground. In the second year, an investigation was begun of the possibilities of improvement in tenement houses, which it is not too much to say has led up to the immense improvement in that class of dwellings throughout the United States; and in the third year it was directed by an act of the Legislature on April 6, 1872, to "consider the general subject of the disposition of the sewage of towns and cities and to report to the next Legislature their views, with such information as they can obtain upon the subject, from our own or other lands." This was the beginning of the accurate study of a subject that has a personal interest for every man, woman, and child. It has been prosecuted uninterruptedly since, and at the end of nearly two decades, in 1890, it put forth its monumental and authoritative three-volume report, one of which relates to the general work of the board, one to Purification of Sewage and Water, and one to Examination of Water Supplies. Dr. Bowditch had said in 1869, "Public health has so wide a field that help is needed from all—from the chemist, the engineer, the naturalist, and from the humblest citizen as well as the highest statesman." He didn't mention the bacteriologist, because that interesting personage did not exist. He was beginning to be evolved in Pasteur, who was studying the "parasitic diseases of silkworms," and in Tyndall, who was earnestly probing the truth or falsity of the doctrine of "spontaneous generation," but, as we now know many of him, he was *non est*. No less than four chemists *par excellence*, one civil engineer, and one professed biologist, outside the regular corps of medical and other contributors, help to make this a work that puts this country in advance of all Europe, and which will find a place in all scientific libraries.

Typhoid Fever in Michigan in 1890. The figures represent the number of persons per 10,000 inhabitants. They were compiled from the State Board's "Vital Statistics," obtained from the reports of local Health Officers.



In 1876 Dr. Bowditch made an address at Philadelphia on the then status of preventive medicine, in which he prophesied a grand future for it, and said, "The touchstone which tests the

earnestness of any individual or community in reference to any subject is a willingness to spend money in the furtherance of it," and the five hundred dollars that was to be spent in 1849, in finding out whether the State had best do anything toward public hygiene, and the $62,876.82 that was spent in 1893 for expert work by her trained corps of sanitarians, are capital indices of the contrasting condition of public opinion at the two periods.

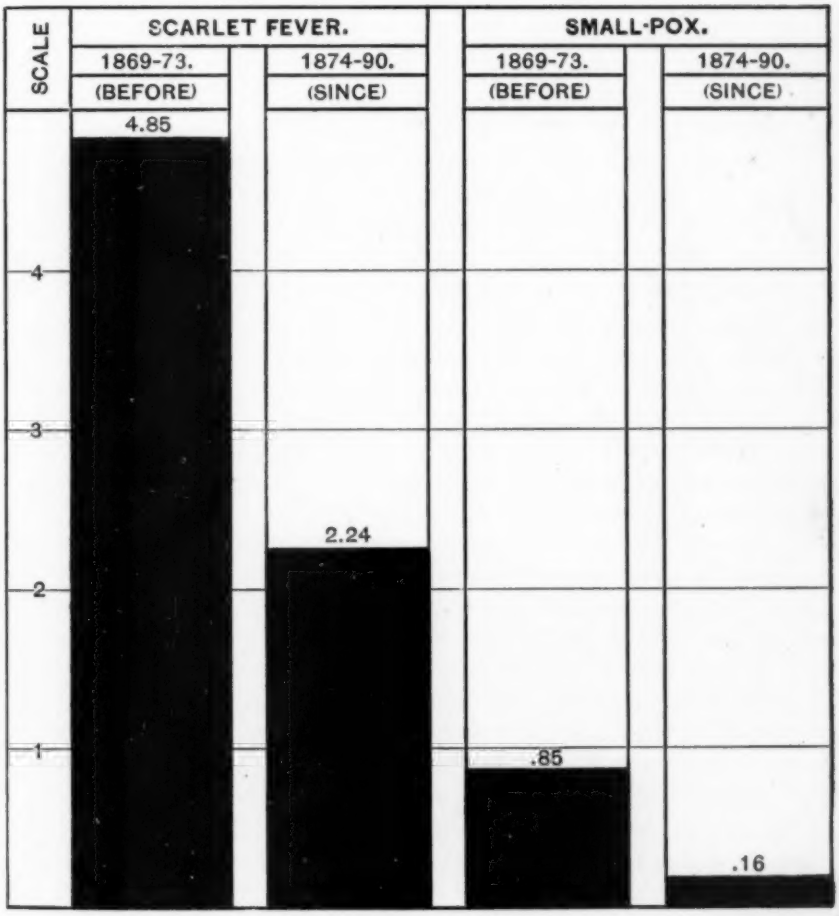
Knowledge and light can not be fenced in or shut out, and the example set in the early home of the Puritans saw its first answering spark on the Pacific coast. It was only two decades since the irruption of the Forty-niners when California, in 1870, established her State Board, "in order to remain on the level of other intelligent people in other States." Her influential citizens had gone from the East as grown men, and some of them had been disciples of Lemuel Shattuck in Boston. Some of our young States have made astonishing advances, because not hampered with a set of conservative obstructionists, and when once started on the track of progress have shown a fruitful activity quite overshadowing the action of older communities. In the very next year Minnesota established a State Board, and thus a nucleus for the growing work of preventive medicine was planted on the four borders of the land, that at New Orleans being the most palpable and obvious, as the quarantining and disinfecting and fumigating of yellow fever, is a much more perceptible process than the noiseless but sure elimination of malarial fever from Maryland by extensive sanitary underdraining.

Two of the men who had investigated the Maplewood fever were professors in the medical college at Ann Arbor. They were indefatigable in efforts to influence the Legislature, and did not rest till Michigan had a State Board of Health, with Dr. Henry B. Baker as its secretary—an enthusiastic knight of sanitary science, possessed of a phenomenal ingenuity in popularizing its study among the million, and in making its work valuable. The work it has done in reducing the death-rate from scarlatina, diphtheria, and smallpox is a true nineteenth-century miracle.

Maryland and the District of Columbia followed in 1874, Mississippi in 1875, and Tennessee in 1877. It required eight years to get ten boards, and when we scan the legislation that gave them being, and see how little money was given them to work with—scarcely enough to pay necessary postage on the letters that must pass before any *rapport* could be established between the central authority and the separate municipalities—it is apparent that the public mind was far from convinced as to their utility, and the public heart was by no means "fired" with zeal to aid their work. A pathetic story attaches to the North Carolina Board. Dr. Thomas F. Wood—one of those patient, self-

sacrificing men whose worth is never half known till they are dead—had labored unremittingly through the columns of a medical journal that he conducted for a State Board. At last the

Lives saved by Public Health work, by comparison of death-rate in Michigan before and after the establishment of the State Board of Health. Compiled from the Vital Statistics gathered by local Health Officers, and showing at a glance the value of enforced sanitation. Lives saved from scarlet fever in seventeen years—7,265.



Legislature yielded to his importunate zeal. He devoted the entire earnings of his journal to sustaining it for four years of "anxiety and hardship"; but the blood of the martyrs has been the most fertilizing material that has ever been expended on this crooked old earth, and before his lamented death in the prime of life in 1892, he saw his State with a thoroughly organized health service in every corner.

Lack of space forbids a detailed statement of the work which at the close of the first decade had gained such a momentum that thirty-seven boards in as many States have been formed, young Oklahoma—bent on having every improvement that can attract immigration—bringing up the rear. Most of them are composed entirely of physicians. No commendations are too strong for these true knights of science, who, in the spirit of "truth for truth's sake," have labored unceasingly and unselfishly to promote preventive medicine.

The modern State Health Board is a highly organized educational machine, in each State employing experts to investigate the mistakes and errors, the needs and advantages of the region. At the first menace of invasion by cholera, yellow fever, or smallpox the State is at once transformed into a camp of instruction, through the myriads of pamphlets and leaflets that fly on the wings of every outgoing train to the farthest hamlet or lumber camp or mine, in many tongues—a true pentecostal dispensation of saving light and knowledge. It is twenty-five years since the first one drew its first timid breath. State medicine is now rapidly growing and will be a giant. Its twenty-fifth birthday seemed a good milestone at which to pause and, in mercantile parlance, "take account of stock." A circular letter was sent out to all the secretaries as follows:

1. When was your State Board established?
2. To the reform of what sanitary errors or abuses did it address itself?
3. What obstacles did it encounter?
4. What positive results has it effected?
5. By what methods does it promote sanitary and hygienic reforms?

From all but three, careful, painstaking, and most courteous answers have been received, often accompanied by documents of inestimable value, both as presenting a graphic picture of sanitation to-day in the localities whence they come, and as a mine of sanitary information.*

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* The names of the gentlemen thus kindly favoring me, and of the States to which they belong, are as follow: Alabama, Jerome Cochrane, M. D.; Arkansas, D. W. Holman; California, J. R. Lane, M. D.; Connecticut, Prof. C. A. Lindsley, M. D.; Delaware, F. B. Frazer; District of Columbia, W. C. Woodward, M. D.; Florida, Joseph Y. Porter, M. D.; Illinois, J. W. Scott; Indiana, C. N. Metcalf, M. D.; Iowa, J. F. Kennedy, M. D.; Kansas, M. O'Brien, M. D.; Kentucky, J. N. McCormac, M. D.; Louisiana, W. R. Harman, M. D.; Maine, A. S. Young, M. D.; Maryland, James A. Stewart, M. D.; Massachusetts, G. W. Abbott, M. D.; Michigan, Henry B. Baker, M. D.; Minnesota, C. N. Hewitt, M. D.; Mississippi, Wirt Johnson, M. D.; Missouri, R. C. Atkinson, M. D.; New Hampshire, Irving A. Watson, M. D.; New Jersey, W. D. Mitchell, M. D.; New York, J. S. Barnes, M. D.; Rhode Island, Gardner T. Swarts; South Carolina, H. D. Frazer, M. D.; North Carolina, Richard

The most glaring of all sanitary errors a quarter of a century ago was ignorance of the danger that lurks in an impure water supply, and the early efforts of most of the boards was directed to the protection of inland waters from pollution, and to inducing people in the older sections of the country whose ancient wells proved incomparable disease-breeders, to provide themselves with "piped"—i. e., protected—water wherever obtainable from an uncontaminated source. The legislative appropriations of money made it possible for the frontier and coast States to put in force efficient quarantine against those incursions of infectious disease that every now and again will strive to enter, in the person of the irrepressible immigrant. The newer, far western States have been the stamping-ground of quacks of every type, and the place where men with credentials bought from some "diploma mill" have passed as physicians, and where others, honest enough, have established themselves as doctors after acquiring so little of medical knowledge that an eastern man would not trust them with the care of a favorite cat. All those States have made a uniform push for registration of physicians, and in those where there are medical colleges, for a longer and more thorough course of medical education. The early boards had to make headway against prejudice and vested abuses, but they labored to enlighten and educate the people, and they reached a turn of the tide at about the end of the first decade, so that those that have been formed since were able at once to set about positive measures for good, and did not have to waste strength on combating obstacles. The history of the health boards supplies a beautiful example of the evolution of a sustaining public opinion—certainly "at the top" among the educated.

To the query, "What obstacles did it encounter?" there comes up one uniform chorus of groans over the apathy, indifference, and ignorance of the populace, and in some cases hostility from the medical profession itself, of whom better things might have been expected. If they tremble lest the world shall educate and sanitate itself into such perfect health that there will be no demand for their services, they can dismiss their foolish fears, for the more intelligent a man becomes in the structure of this "harp of a thousand strings," and the delicate adjustments on which its harmony depends, the less willing will he be to trust to an ignoramus when it gets out of tune. A long history might be made up of actual instances where greed of money has attempted

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M. Lewis, M. D.; North Dakota, F. H. De Vaux, M. D.; Ohio, C. O. Probst, M. D.; Oklahoma, J. O. Overton, M. D.; Pennsylvania, Benjamin Lee, M. D.; Tennessee, J. Berrien Lindsley, M. D.; Washington, G. S. Armstrong, M. D.; West Virginia, N. D. Baker; Wisconsin, U. O. B. Wingate, M. D.

to block the onward progress of sanitation. In Pennsylvania, added to indifference and ignorance, "was the direct and persistent opposition of manufacturers of every kind, the prosecution of whose business led them to dispose of their waste, no matter of how offensive a character, in the least expensive way, that is, by dumping it into the public streams." In Rhode Island there was "the usual and expected objection to the prevention of the sale of glandered and other diseased animals." In Maryland the obstacles were "ignorance, selfishness, obstinacy, old habits and customs, and the difficulty of obtaining such legislation as was necessary to sustain the authority of the board in suppressing nuisances." In Missouri it was "the opposition of all the unclean and dishonest who are practicing or pretending to practice medicine, and of the ignorant people outside of the profession who seem to be anxious to be humbugged and defrauded." In Michigan it was "the inertia due to the general ignorance of the people on sanitary subjects, and the sentiment of economy prompting to opposition on account of the cost; in North Carolina, "apathy, indifference, in some cases positive hostility, when the demand was made for money or for work that was inconvenient"; in Iowa, "ignorance of the masses." "Ignorance," "lack of funds," runs with tiresome iteration through many, for, though there are ample legal powers, there must be money to aid in their enforcement. One writer puts the difficulty very delicately as "civilization imperfectly developed"; while the Connecticut secretary comes down to details thus: "The obstacles in the way have been the unsuitableness of the persons who, *ex officio*, constituted the local boards of health, the paralysis of these boards resulting from long years of inaction and torpidity, and the settled conviction on the part of the majority of the old communities, that the habits and customs of their ancestors were good enough." The Rhode Island man goes still deeper into the psychological mysteries of the matter thus: "From the early instructions and habits of our first settler, Roger Williams, we have all been led to believe that we severally and individually are a law unto ourselves, and as soon as any new law or change is ordered, even by the representatives of the individual, it becomes at once our duty to oppose it"; and the secretary of Tennessee says, "Those obstacles usually encountered by missionaries in any field, who come to teach the new gospel that 'thou art thy brother's keeper.'"

The third question was, "What positive results has your Board achieved?" Before going into details, we would say the first great collective beneficial result of sanitation is in the moral realm —the successful propagation of the idea that a man has no more right to poison the water which his neighbor must drink, or the air he must breathe, than he has to put strychnine in his food—

either is potential murder, and is coming to be so regarded; and the next touches the sphere of the affections, as it has saved thousands and thousands of lives, as a long catalogue of diminished death-rates testifies. At the World's Fair Dr. Abbott had prepared a series of sanitary maps of Massachusetts, exhibiting the comparative ravages of the communicable diseases. The towns most deeply stricken by them were colored a bright carmine, and, by different patterns of cross-hatchings, the greater or lesser prevalence was indicated by lighter and lighter shadings, till at last one or two happy localities were left a pure white. In the map of *Typhoid Fever* one was instantly struck with the deeper dye of the rural districts, while for a radius of a hundred miles around Boston hardly a town showed more than a mild pink, and the general effect changed the whole aspect of that half of the State. The reason is not far to seek. The perpetual exhortations to "get pure water" have so moved the people that perhaps there is more "piped" water in that section than in any other equal area in the United States, a fact that takes on fresh significance when we consider that there is a population of two hundred and seventy-five persons to the square mile, and that parts of it have been lived in more than two centuries and a half. Such conditions call for much more vigilant supervision than "out west," where one person to the square mile lives on fresh, uncontaminated soil. That lighter shading means that to-day thousands of young men and women are "breathing this sweet air of life" who, but for the action that led up to it, and all it means, would be filling untimely graves.

The whole subject of vaccination, revaccination, and the establishment of vaccine stations where pure, active, and fresh bovine lymph is produced, has been so frequently and thoroughly discussed and acted upon by the several boards, that it is strange that any intelligent person should allow himself or his family to remain for a day unvaccinated. Still, in Minnesota seventy per cent of the school children are not vaccinated, and the knowledge of this fact so moved the State Board, that they at once established a station for the production of a safe virus. In Massachusetts, in the epidemic of 1872, there were five thousand six hundred and six cases of it, and in one year since there were but two. Self-interest has protected the State from the evil result of the incursion of unvaccinated French Canadians, for they are not allowed to go to work in the factories till after they show the vaccination certificate. In Rhode Island general gratuitous vaccination and the compulsory vaccination of school children have reduced the mortality to one twentieth of what it was, though this is a manufacturing State, subject to the irruption of hordes of the unvaccinated.

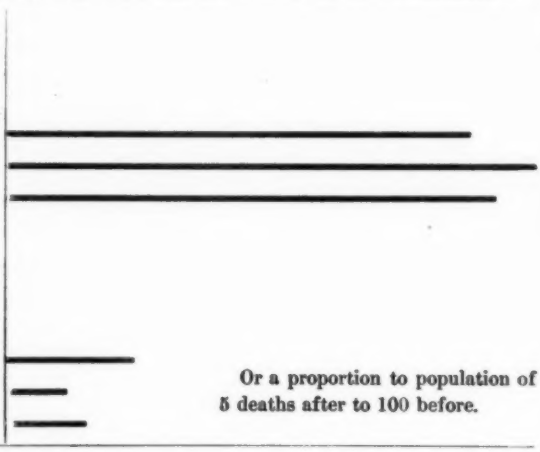
Mortality from Smallpox in Rhode Island before and after General Gratuitous Vaccination and Compulsory Vaccination of School Children.

BEFORE.

Five-year Periods.	Population.	Mortality from smallpox.
1863–'67...	184,965	44
1868–'72...	217,353	48
1873–'77...	258,239	46

AFTER.

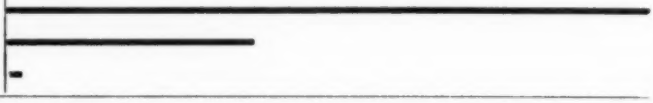
Five-year Periods.	Population.	Mortality from smallpox.
1878–'82...	276,531	7
1883–'87...	304,284	3
1888–'92...	345,506	4



Or a proportion to population of 5 deaths after to 100 before.

Deaths from Smallpox in Massachusetts, by Decades.

Ten-year Periods.	Deaths.
1863–'72...	2,375
1873–'82...	922
1883–'92...	51



Previously to 1872 there had been an almost universal neglect of vaccination, and the idea of compulsory vaccination had not come into people's minds. The great epidemic of 1872, which swept around the world and destroyed thousands of lives, had the effect of rousing people to the value and practice of vaccination. Still, the factory towns, which were ever receiving fresh relays of the unvaccinated from Canada—especially the paper-mill towns, with rags from all over the world—would every now and again have an outbreak. At last stringent laws were passed at the instigation of the Board of Health for the vaccination of school children, and self interest accomplished the work in factories with such obvious good results that now a stringent State law aids in producing the result shown in the smallest of the three lines.

There is no need to recite how the States whose situation exposes them to cholera and yellow fever have, through their boards, provided themselves with all the means of enforcing necessary quarantine, and with the best disinfecting apparatus known to science, the mere possession of which has put old-fashioned panics to flight. Alas for Georgia! She stands forth a dismal foil to the above, and a dark object lesson. When yellow fever smote her second commercial town in 1893, her former State Board had been abolished and there was no organized *authority*. The Brunswick epidemic ought to silence the rivalries among doctors

that led to the abolition of the board. Nashville, Tenn., in 1878, made enlightened preparations under the leadership of Dr. J. D. Plunket,* and, though there were twenty-four cases, either coming from other places or originating there, they were restricted, cared for in a hospital made ready, and the business of the city went on with no interruption; but there was concentrated authority at the center of things.

The large southern and western States—each of which is a sort of empire—have organized their work largely by counties, each of which has a board that reports to the central State Board, and they are doing a valuable work in the collection and collation of vital statistics—a work in which our country lags far behind European lands. Should our Congress see fit to create the Bureau of Public Health within the Department of the Interior, now asked for by the New York Academy of Medicine, and all sensible sanitary bodies everywhere, it would be bringing our country into step with other progressive peoples. Dr. Abbott, of Massachusetts, made a plea before the Sanitary Congress at Chicago for a national registration. Is not a numbering of the people, and an account of their sicknesses and deaths, of as much importance as the acreage of wheat or corn, and the number of acres that have been destroyed by weevils or fungi? It would seem that a central authority can better fence out those contagious diseases that pay no attention to State lines, than one diffused among a number of organizations, even though each one has its inalienable State rights.

The scientific and safe sanitation of the Columbian Fair grounds in Chicago, and the direct reduction of the typhoid-fever rate there from the hour when water from the contaminated intakes was shut off, and the new four-mile tunnel began to be used, is a distinct triumph of the science of sanitation.

The thirty-seven boards have very different phases of sanitary and hygienic errors brought to their attention, and naturally each attacks the evil that is most importunate in his section, and the result is that there is no detail of the house—its site, its material, construction, plumbing, heating, lighting, or ventilation—that is not exhaustively discussed by some competent mind; nothing pertaining to the hygiene of the individual escapes them, from protecting the newly born from blindness, up through all the perils of youth, middle life, and age, till at last he finds sanitary sepulture at the hands of a funeral director who has been carefully taught by his State board how to conduct the entombment of those who have died of the most virulent infections with perfect safety to the living. The frauds and adulterations in foods

* No connection of the writer, and spells his name differently.

and drugs are exposed, health resorts, prisons, hospitals, and public buildings are inspected, the poor are provided with sanitary homes—in short, the people are watched over and defended from the cradle to the grave. The steady lengthening of human life shows that their intelligent efforts are not wasted. The annual reports are an incomparable means of mutual education, for no new method of investigation or illustration appears in one that is not availed of by the others. The mere titles of the different topics to which study has been directed would fill several pages of this magazine.

The last query was, "By what methods does it promote sanitary and hygienic reforms?" The comprehensive reply deduced from the thirty-seven letters is "the education of the people" through reports, circulars, pamphlets, and leaflets, accompanied by most ingenious and instructive maps, charts, and graphic diagrams. While one of the most potent means of convincing and moving men is the human voice, with a clear brain, an enthusiastic soul, and a worthy cause behind it, the most lasting and universal is a judicious diffusion of printer's ink. Most of the boards keep on hand, circulars, giving plain directions how to care for and limit the spread of contagious diseases—a work made easier since bacteriology became the definite science that it now is. In one sanitary convention complaint was made that these tracts in large numbers remained piled up in the offices of the board. But there comes a moment when they achieve their destiny. Let a case of scarlatina break out, as soon as the telegraph can order, and the mail bring these documents, people are conning them for a way of escape, and that locality will never again be as densely ignorant as it was. The State of Pennsylvania sends out twenty-three different ones, and some of them printed in many tongues, for the benefit of her polyglot people; and there are few of the States that have not established similar fountains to send forth a fertilizing irrigation of knowledge. In the States of Michigan and Pennsylvania conventions held in localities that need them have been found of the greatest value. The first holds four a year, and already forty-eight separate localities have experienced this quickening visitation. In Ohio the State Board holds joint conventions now with the school teachers, and again with the "funeral directors." The Maine Board prints a monthly journal, and sends it to school teachers, clergymen, and heads of local boards. Maryland tries to send tracts to every family. In the larger and more sparsely settled western States the central board gets into very close and vital relations with local boards, and as a consequence two States, Tennessee and Indiana, report, "We no longer have epidemics of diphtheria, since we have learned to limit and counteract it." In Minnesota sixteen hundred and thirty local boards

reported to the central authority in 1892, which proves that at least sixteen hundred and thirty persons are not asleep. The secretary wrote three thousand one hundred and fifty-three letters on subjects ranging from glanders and leprosy to vital statistics.

Says the secretary of Kentucky, "The growth of sanitary work in public confidence has been very marked, especially in the last three or four years."

The capital of our country presents a very perfect object lesson of what thorough sanitation is; it formerly was bad, as bad could be.

Progressive physicians early perceived the trend of preventive medicine, and also the advantage of a free interchange of ideas, and have now been formed into the American Public Health Association twenty-one years, through which Mexico, Canada, and the United States form a sanitary solidarity.

In 1879 the Sanitary Council of the Mississippi Valley was formed, and the struggle that the Nestor of sanitarians, Dr. J. H. Rauch, and Dr. Holt, had with the authorities of Louisiana to prevent concealment and dissimulation makes a lively and interesting story; but for twelve years there has been practically no yellow fever in New Orleans (since 1880), and the commercial value of the services of that council are immense, while there is no measuring the confidence inspired in millions of minds, that they will surely keep the fever or the cholera out.

Incidentally the new profession of sanitary engineer has come into being, and an immense amount of sanitary literature has accumulated. What of the future? The best sign of the times we have kept for the last: women are actually becoming interested in practical sanitation, and large classes of them have *paid money* to be instructed in it in Boston lately. The movement of these public bodies is important but extraneous; this feminine interest is vital and interstitial, and under woman's influence we look to see the physical life made doubly worth the living.

A hundred years ago to-day Jenner alone knew the secret of the means by which smallpox was to be virtually banished. Now hundreds of people know the precise conditions under which a successful crusade of extermination against consumption can be conducted. Is it too much to hope that fifty years will see it driven out from among civilized peoples?

PROF. CYRUS THOMAS, who has made special studies of the subject for several years, has reached the conclusion that ancient Mexican civilization originated with the Malays of the South Pacific islands, and believes that he has established a connection between the languages of those tribes and that of the Mayas, showing it to be a direct offshoot from them.

ETHICS IN NATURAL LAW.*

By Dr. LEWIS G. JANES.

RESTING recently for a brief while, apart from the stress and turmoil of metropolitan life, close to the heart of Nature, in a tree-embowered home in a quiet New Jersey hamlet, whence the eye wandered across green fields to a distant wooded crest, inviting conquest by its promise of entrancing views—the sun flickering here and there through the overhanging boughs of the clustering maples which furnished grateful protection from its intenser heats—the earth-goddess wooed me irresistibly to optimistic contemplation of her supreme beneficence. But anon, in cyclonic rage, she hid the mountain crest in blinding mists, tossed the overhanging branches until they swayed like ocean waves before the blast, hurled limbs and fruit to earth, and through the long vigil of the night aroused the most lively feelings of apprehension for the safety of life and property. Again, treading the wooded crest in thoughtful contemplation, beneath its peaceful summer dress I found evidences of the Titanic struggles of former ages—huge columns of basaltic rock upheaved by Plutonic forces, and here, where the stream runs so gently and falls so musically to the lower level of the plain, was once the crater of a now long-extinct volcano.

From ages dim and remote, when the earth was a molten ball, the theater of fierce Plutonic activities, to the present time, when it woos and buffets man by turns as he applies his energies to its conquest, the "struggle for existence" has gone forward, determining in partnership with Nature's other evolutionary conditions the form and structure of continents and seas, the birth and growth of animal and vegetable life upon the planet, the origin of the human race out of brute ancestral conditions, and its progress toward a higher civilization.

Taking man as he is at his best, with a high sense of ethical obligation dominant in his consciousness, and aspirations for a nobler personality and better social conditions guiding his actions, what shall we say of the rational attitude of his mind toward the cosmic process which has given him birth, and upon which he is still dependent for the physical conditions of life? What of his moral nature as related to this process? What of the ethical attitude of the universe to man?

Upon this problem Prof. Huxley, one of the most versatile and virile writers among the modern apostles of the doctrine of evolution, has recently exercised his trenchant pen; and the outcome

* Read before the Congress of Evolutionists, Chicago, September 30, 1893.

of his Romanes address at Oxford has been hailed by skeptics as to the theory of evolution as a complete surrender of its claims in the higher fields of ethics and sociology. Using the nursery tale of Jack and the Beanstalk as illustration, Prof. Huxley assumes with the Hindu and Buddhist sages that the cosmic process is one of recurring cyclical changes—of alternating development and disintegration—in which no real and definite progress is discernible. And what is true in the field of physics, he says, "is true of living things in general. . . . The process of life presents the same appearance of cyclical evolution." Moreover, "where the cosmopoietic energy works through sentient beings, there arises, among its other manifestations, that which we call pain and suffering. This baleful product of evolution increases in quantity and intensity, with advancing grades of animal organization, until it attains its highest level in man. Further, the consummation is not reached in man, the mere animal; nor in man the wholly or half savage, but only in man the member of an organized polity; and it is a necessary consequence of his attempt to live in this way—that is, under those conditions which are essential to the full development of his noblest powers." Ergo, he tacitly and avowedly assumes, no moral tendency or purpose or effect are predicable of the cosmic energy; on the contrary, "the ethical progress of society depends, not on imitating the cosmic process, still less in running away from it, but in combating it." The relation of man to Nature is one of insoluble dualism and eternal antagonism. His only hope of individual salvation and social amelioration is to struggle continually against her cosmic tendencies, enduring an ever-increasing consciousness of the stress and pain involved of necessity in the age-long struggle. As a teacher in the field of ethics, she can only show him "how not to do it."

Without attempting an elaborate argument in reply to Prof. Huxley's positions, which have already run the gantlet of much favorable and adverse criticism, I may perhaps be permitted to make them the text of a brief exposition of what I conceive to be the true and logical bearing of evolutionary thought upon the great problem of man's relation to the universe, and of his moral nature to those physical and biological conditions under which he has come into existence, and upon normal relations to which his well-being admittedly depends.

Let me ask, at the outset, by what authority as an evolutionist does Prof. Huxley revert to the old theological conception which places Nature and man in radical antithesis? Is not the human mind, including its loftiest ethical determinations, as much the product of evolution, a part of universal Nature, as the brute forces which control the struggle for existence in the lower planes

of being? If that in us which is to oppose and correct the cosmic process is not itself a product of the cosmic process, whence does it come? To the consistent evolutionist there could seem to be but one answer to this question. As such, Prof. Huxley would hardly fall back upon the discredited dogma of special creation, and no other refuge is left him from the logic of that conclusion which he has so persistently ignored.

Leaving out the Oriental imaginings and metaphysical speculations which so largely tinge and illustrate the thought of Prof. Huxley, and confining ourselves to what science definitely assures us regarding the cosmic process as illustrated in our own little earth, we are surely justified in viewing it as the exponent of something more and different from a merely cyclical alternation of evolution and degeneration. Whether viewed in its purely physical or in its biological aspects, the process of evolution on this planet has been one of progressive refinement, development, and progress—from a molten ball to a solid globe; from the theater of terrific Plutonic activities to a condition where such activities are rare and exceptional; from the coarse and rank vegetation of the Carboniferous era to the more delicate and beautiful growths of our own time; from lower to higher forms of life, from moneron to ape and from ape to man; from savagery to barbarism and from barbarism to civilization: such is the story of evolution as written in rock and soil, the rude inscriptions of the earlier races, and the nature of man himself, so plainly that he who runs may read. Occasional lapse and degeneration have indeed been incidental to this progress, rendering it rhythmical rather than serial in its method; but this does not detract from the impressive reality of evolution's majestic march through the centuries.

Not only has Prof. Huxley erred, as it appears to me, in giving a partial interpretation of the trend and meaning of the cosmic process in inanimate Nature, he seems to be still more grievously at fault in interpreting its significance when it mounts to sentiency in animal and human organisms. One is forced to wonder by what curious mental bias he was led to debit Nature with all the pain, misery, and suffering that sentiency implies, without crediting it with the conscious satisfactions, pleasure, and happiness which are equally the product of the evolutionary process. Mr. Spencer has shown by arguments which I believe to be unanswerable, and to which Mr. Huxley does not even allude in this address, that that "fullness of life," which is the final evolutionary test of genuine advancement in mental capacity, individual character, and progressive social amelioration, is directly proportionate to the relative amount of subjective satisfactions in sentient organisms, and that all progress is conditioned upon the

excess of these satisfactions over the concomitant pain and suffering. The contrary assumption, he has shown, would result in a *reductio ad absurdum* so complete as to be logically unthinkable. The "pains innumerable and immeasurably great," which Prof. Huxley finds to be the accompaniment of the highest functional development of the sentient organism, are, on the whole, counterbalanced by pleasures still more immeasurable and complete.

Indeed, the "ape and tiger" surviving in human dispositions, the pains and griefs, the miseries and crimes, which are a part of the experience of civilized man, constituting his inheritance from a myriad generations of brute ancestors, are the *sine qua non* of all morality and all ethical progress. They furnish the *pou sto* of ethics, the underlying conditions without which there could be no such thing as a moral being. There can be no light without a concomitant shadow; all we can rationally ask is that the light shall furnish the medium for seeing the picture of life as it is. Without the shadows, no beauty of landscape or human countenance; without the darker shadows of suffering and sin, no moral beauty—no ethical advancement.

Prof. Huxley well says that "ape and tiger methods are not reconcilable with the ethical principle." This is certainly true of beings possessing a developed moral consciousness; but nothing is surer, from the evolutionist's standpoint, than that the sense of moral obligation was sired by these very "ape and tiger methods" as they have prevailed among the lower orders of sentient beings. The sense of obligation is primarily purely egoistic. The "ought" of primitive man was not a moral obligation; it was a recognition of something *owed* to himself. That impulse to self-preservation which is proverbially the first law of Nature, out of consciousness of obligation to self, developed, through experience, the application of this sense of obligation to that larger self, the family; through gregarious association to the still growing self, the herd or tribe; and again on to the state, the nation, and in the consciousness of a few—the perfect flower and fruitage of cosmic evolution—to man as man, to all forms of sentient life, to the earth itself as the teeming mother of the human race.

The sense of duty, as we now understand it, was not developed until the remote and indirect motive of race-maintenance and altruistic service was consciously and voluntarily substituted for the primary, egoistic motive of self-preservation. Yet, as I have elsewhere shown, "here has been no new creation, but merely a process of transformation, of evolution. The 'raw material' of morality is found in the simplest orderly manifestations of volitional activities in organic Nature; yes, back even in those steadfast laws and tendencies which are manifest in the action of the inorganic universe . . . In the last analysis, it is not *two* things

that fill the mind with awe, as in the familiar phrase of Kant, but *one thing*, whether it be manifested in the order of the galaxies or in the orderly impulse to right action which we term conscience or duty."* That principle of gravitation which secures order among whirling atoms and orbs throughout the interstellar spaces finds its complete analogue in human societies in the sense of moral obligation. Here is no mere transcendental speculation, but a logical deduction from scientifically demonstrated facts. What is that very inviolability of law which is the stumbling-block of crude, sentimental thinkers on the problems of man's relation to the universe but an expression of steadfastness and honesty in Nature's dealings with us? How much better is it than the capricious Providence of the theologian!

Undoubtedly there was a distinct progress in morals, as Prof. Huxley declares, when action from right motive came to be regarded as the true moral test, in the place of acts conventionally estimated as right, when judged by their results, according to standards established by the dictum of political or ecclesiastical authority. But the reaction has been too great; ethical teachers have come to place the entire stress on the motive, ignoring the actual objective results of individual activities. The new science of ethics, which is dominated by the doctrine of evolution, finds an objective law of right, inherent in the nature of things, dominating all human associations, and makes conformity to this law, both in motive and in action, the highest moral ultimatum. The Quaker doctrine of the "inner light" and the transcendental theory of intuitional ethics need to be supplemented and corrected by the lessons of science and experience. Mr. Spencer has ably shown that individual intuition is born out of race experience, and that ethical theories hitherto regarded as irreconcilably antagonistic are harmonized by the solvent method of evolution. So, also, his much-misunderstood doctrine of the Unknowable supplements the Berkeleian idealism and Buddhistic nihilism which Prof. Huxley seems to regard as the highest logical resultants of human speculation; and by showing the absurdity and unthinkableness of the conception of a sequence of phenomena, either mental or material, without a nexus of reality, and scientifically demonstrating the symbolical character of our sense-perceptions, he has dealt a deathblow to the old-fashioned materialism and substituted for the metaphysical conception of a substance apart from phenomena — at best a fruitless abstraction — the strictly logical, affirmative, and scientific conception of a reality immanent in all phenomena, inconceivable, indeed, in its essential nature, because of the limitations of our knowing faculties,

* The Evolution of Morals.

but the existence and potency of which constitute the most certain of all our knowledge.

Not Nirvana, therefore, but effort; not death, but life, the development of moral power, and an ever-deepening moral consciousness through conflict with evil, is the lesson of evolutionary ethics. Nor are we left to despair at the duration and impotency of the struggle. Its final subjective outcome is foreseen to be—like that of all other conscious endeavor, become habitual—a natural spontaneity of right action wherein men shall serve the right neither for hope of reward nor fear of penalty, but from a divine inner necessity, which at once compels the volition and brings the unsought compensation of the highest intellectual satisfactions.

But, says Prof. Huxley, admitting that the moral consciousness is the result of evolution, "immoral as well as moral sentiments have been evolved by evolution. . . . There is, so far, as much natural sanction for one as for the other. . . . Cosmic evolution is incompetent to furnish any better reason why what we call good is preferable to what we call evil than we had before." Let it be granted that the facts of human experience are more powerful than any theories as guides to individual action. If it were not so, the progress of the race would indeed be slow. But what is this but a recognition of the fact that morality is the result of an actual process of evolution which is independent of all mere doctrinal speculation? No rational theory of ethics, however, can fail to recognize that a true philosophy of life, a correct understanding of its facts, must furnish a tremendous incentive to right action. Just here, indeed, has been one of the chief stumbling-blocks in the path of moral progress. The race has been weighed down with disheartening theories of total depravity, moral lapse, and the inefficacy of natural effort for the improvement of character, at variance with all the known facts of human history. But evolution demonstrates that immoral and even criminal actions as we now regard them are usually survivals of customs or habits at some past time justified by the conditions of the physical and social environment. This furnishes at once hope for further progress by demonstrating the progress which has actually taken place and evolved a sense of evil in the commission of unsocial acts, and a hint as to the right method of promoting advancement in morally defective individuals. The recognition of the defect as a survival of past customary conditions is itself conclusive testimony to moral progress. The ultimate objective test of the moral character of an action is its influence in promoting fullness of life in the individual and in the race. To say that there is as much natural sanction for an immoral as for a moral action because both exist in the present stage of social evolution, is equiva-

lent to saying that there is an equal sanction for the violation of any other natural law with that for its obedience. The sanction of an action in either instance lies not in the mere fact of its performance, but in the improved conditions, material or social, which are its resultant effects. That which is upbuilding, which tends to fullness of life, is right; that which tends to deterioration and retrogression is wrong.

Mr. Huxley apparently gives away his entire case against evolutionary ethics by the assertion that the practice of goodness is directed "not so much to the survival of the fittest as to *fitting as many as possible to survive.*" But surely it can not be doubted that those "fitted to survive" *will* survive; hence this confession constitutes a complete justification of evolutionary ethics. Viewed at short range by absolute standards, it may indeed be true that "survival of the fittest" is not always survival of the best. Relatively, however, it is the survival of the *best possible under existing conditions;* it points toward the morally perfect which can only be attained through repeated approximations of the relatively good.

It is true, indeed, that "the theory of evolution furnishes no millennial expectations" for the immediate future, and Prof. Huxley has not emphasized too strongly the importance of human intelligence and will in effecting moral regeneration. But these are powerful for good only as they are duly trained and cultivated; only as they rigidly note both cosmic and social conditions, and correctly estimate the trend and result of all the complex forces which center upon the life of the individual. It is the great virtue of the evolutionary ethic that it calls man back from the cloudland of metaphysical speculation, and seeks to enlighten his intellect and guide his steps by appeals to the scientifically ascertained facts of human experience and the laws by which they are governed. Back to Nature, not in her statical aspects, as dreamed by Rousseau and the eighteenth-century philosophers, but in her dynamical and evolutionary aspects, must we ever go for ethical guidance, encouragement, and inspiration.

To Herbert Spencer, more than any other among the apostles of evolutionary doctrines, we owe the logical demonstration of the unity of man and the universe which eternally forbids the separation of his moral nature from those conditions out of which his whole being had its birth, and to which it is at all times vitally related. No morality in the universe? None, then, is possible in man. Existing in man, it is predicable also of his great world-mother. This is the irresistible logic of evolutionary ethics. And of him, the ripest thinker on this problem now living, it may well be affirmed, in the language of a poet of the new dispensation:

"Man's thought is like Antæus, and must be
Touched to the ground of Nature to regain
Fresh force, new impulse, else it would remain
Dead, in the grip of strong Authority.
But, once thereon reset, 'tis like a tree,
Sap-swollen in springtime; bonds may not restrain,
Nor weight repress; its rootlets rend in twain
Dead stones, and walls, and rocks, resistlessly.

"Thine then it was to touch dead thoughts to earth
Till of old dreams sprang new philosophy,
From visions, systems, and beneath thy spell
Swift they uprose, like magic palaces,
Thyself half-conscious only of thy worth,
Calm priest of a tremendous oracle!"

ON THE ORIGIN OF WEEKS AND SABBATHS.

By the late Colonel A. B. ELLIS.

ALL over the world we find that peoples who are low in the scale of civilization reckon time by moons. In some cases a moon is the sole measure of time; in others a lunar year, composed of a certain number of moons, has been evolved; but the solar year only appears to come into use when some progress in civilization has been made. The most primitive method of measuring time, that which is found among all savages at the present day, is to count by moons, the recurrence of the moon at regular and short intervals of time affording a natural and easy mode of reckoning its lapse. A moon, or month, is reckoned from the first appearance of a new moon, and as the moon is chiefly visible by night, so it is by nights rather than by days that a moon is computed. In other words, time is measured by moons and nights.

The next step is to divide the moon into periods corresponding with its principal changes, which generally results in its being divided into halves and quarters, the fourteenth to the fifteenth night, which is the night of the full moon, dividing the twenty-nine and a half days which elapse between the advent of two new moons into two. In this connection it is curious to note that we still speak of the "quarters" of the moon. The month is thus divided into four equal periods; but as twenty-nine and a half days will not divide exactly by two or by four, each period consists of seven complete days and some nine hours extra. This is the plan which has been adopted by the Tshi tribes of the Gold Coast of West Africa. They have what may be called a seven-day week, but

which is really a week of seven days and some nine hours, and in consequence each week commences at a different hour of the day. The first day of the first week commences when the new moon is first seen, usually about sunset, and each moon contains exactly four of these periods, or weeks. Say the new moon is visible at 5 P. M. on a Monday, then the first week will terminate about 2 A. M. on the next Tuesday but one, and will contain seven days and eight nights nearly. The second week, commencing at 2 A. M. on Tuesday, will terminate at 11 A. M. on the Tuesday following, and will contain seven and a half days and seven nights, approximately. The third week will terminate at 8 P. M. on the next Tuesday, and the fourth when the next new moon appears. Each of the seven days has a name: 1. Dyo-da, or Adjivo-da. 2. Bnada. 3. Uku-da, or Wuku-da. 4. Yaw-da. 5. Fi-da. 6. Meminda, or Memere-da. 7. Kwasi-da. It is sometimes said that these days correspond to ours, but that is not quite correct. The only correspondence is one of order—i. e., Dyo-da answers to Monday because it is the first of the series, and Fi-da to Friday because it is the fifth; but as the Tshi week is nine hours longer than ours, the days do not correspond in time.

The suffix *da*, which we see attached to these names, is derived from the verb *da*, "to sleep," and shows that, as we should expect, the period is a seven-night period rather than a seven-day period. From its connection with these words, *da*, or *eda*, has now acquired the meaning of "day." A week is *da-pen*, "a set of days," or *nuaotyo*, "eight days," because the week contains seven days and a part of an eighth. *Nua* is the plural of *da*. The word for "day," in contradistinction to "night," is *awia*, which properly means "sun." Month, or moon, is *sram*, a word which is derived from *sra*, "to watch for," and has reference to the custom of watching for the new moon. *Sram-fia*, "moon-appearing," is the beginning of the month, and *sram-wua*, "moon-dying," the end.

The Gã tribes of the Gold Coast likewise have a week of seven days and some nine hours, so that a lunar month consists of four of these periods. Their names for the days are: 1. Dsu. 2. Dsufo. 3. Fso. 4. So. 5. So-ha. 6. Ho. 7. Ho-gba. These seem to consist of three pairs and a single one, viz., the third day. Day and night, as contrasted one with the other, are *fane* and *nyon*, the formor of which probably means "the redness," and no doubt refers to the sun, while the latter means "moon." *Nyon-dse*, "moon-appearing," means the beginning or early part of the month, and *nyon-gbo*, "moon-dying," the end. These two nations afford examples of a seven-day week being formed directly from the lunar month.

Now, as nations progress in knowledge and gain a more or less accurate notion of the solar year, they begin to compute time

by years, rather than by moons. All uncivilized men being exceedingly averse to any change, they first endeavor to combine the old system with the new, and make the year contain twelve or thirteen moons; but experience soon shows them that a solar year does not contain an exact number of moons, and, in the end, they either abandon computation by moons altogether, or else arbitrarily fix the month as being of a certain duration, so as to make twelve or thirteen of them fit into the solar year. Of course, when this is done, the month is no longer coincident with a moon, but is simply what we may call a civil measure of time, quite independent of the moon and its phases. Thus we have made the solar year of three hundred and sixty-five days contain exactly twelve civil months, and to effect this we have distributed between the original twelve lunar months the number of days by which twelve lunar months fell short of a solar year—that is, eleven.*

Next, the same process is applied to the weeks, or subdivisions of a lunar month, and, just as the month is made a civil period having no relation to the moon, so is the week made a civil period having no relation to the lunar month. The month having severed all connection with the moon, the week ceases to mark the phases of the moon; the odd hours, which were required to make the week a true subdivision of a lunar month, are dropped, being no longer of use, and the week remains seven days exactly. The etymology of our own words shows that this was what we did ourselves. The word "month" is derived from "moon," and undoubtedly originally meant a lunar month, while the Anglo-Saxon *mona* (moon) means "measurer," of time understood. The word "fortnight" (fourteen nights), and the old name for week, "sen'night" (seven nights), show that these periods were reckoned by nights, and so had reference to the moon. They were, in fact, half moons and quarter moons, and the latter must have consisted of seven nights and nine hours. The word "week" itself is probably connected with the Anglo-Saxon *weaxan*, "to increase, wax," and had reference to the moon's phases. Sharon Turner says: "In their computation of time, our ancestors reckoned by nights instead of days, and by winters instead of years. Their months were governed by the revolution of the moon." †

The Aztecs afford another example of a people who, having

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* January, March, May, July, August, October, and December have each thirty-one days, or a day and a half more than a lunar month. Total, ten days and half. April, June, September, and November have each thirty days, or half a day more than a lunar month. Total, two days. February, on the other hand, has only twenty-eight days, or a day and a half less than a lunar month. $10\frac{1}{2}+2-1\frac{1}{2}=11$, the number of days required.

† Anglo-Saxons, vol. i, p. 201.

adopted the solar year as a measure of time, made the month a civil period, quite independent of the moon and its phases. Their solar year consisted of eighteen months of twenty days each, with five supplementary days; and they divided each month into four weeks of five days each, on the last of which was the public fair, or market day. This plan had the advantage of making both the month and the year contain an exact number of weeks. The lunar year, though discarded for ordinary computations, was retained for religious purposes, and was divided into periods of thirteen days, corresponding with the phases of the moon.*

Before the Aztecs adopted the civil month of twenty days, they had, if they had subdivided the lunar month at all, probably divided it into six periods, five of five days and one of the remainder of the month, or four days and a half approximately. We say, if they had subdivided the lunar month at all, because the difficulty of dividing twenty-nine days and a half appears to have been too great for many races. In the Society Islands time was reckoned by nights and moons, but any intermediate division was unknown. There were distinct names for each night of the moon. The fifteenth night was called "The moon with a round, full face," and the last night, "This is the night the moon dies." People always asked, "How many nights since?" instead of "How many days since?" These islanders had progressed sufficiently far to have some notion of the solar year. The Maoris of New Zealand reckoned by nights and moons, but had no weeks. Each night possessed a name, regulated by the moon's shape and age. They had a lunar year of thirteen moons.† The inhabitants of Madagascar had advanced beyond the stage of reckoning by moons, and had a solar year with civil months, but no weeks. Their months contained twenty-eight nights, and twelve months, with eighteen intercalary days, made a year. Their year was thus eleven days shorter than the true solar year, so that their New-Year's day fell eleven days earlier each year, till the cycle of thirty-three years was completed, when the festival was again held at the same season.‡

The Society Islanders and the Maoris had thus not subdivided the lunar month, and the Malagasy had not subdivided their civil month, but examples of nations who have done each are fairly numerous. In Ibo (lower Niger) a civil month of twenty-eight days has been adopted, and has been divided into seven weeks of four days each.# The Congoese also have a civil week of four

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* Nadaillac, Prehistoric America, p. 306.

† Thompson, The Story of New Zealand, vol. i, p. 198.

‡ Sibree, Madagascar and its People, p. 206.

Baikie, Narrative of an Exploring Voyage, p. 316.

days.* In Sofala (East Africa), according to De Faria, a civil month of thirty days was adopted, and divided into three weeks of ten days each. As, however, he says that the first day of the first week was the festival of the new moon, there must be some mistake. It looks more as if time were reckoned by lunar months, and consequently, while the first and second week might each be of ten days' duration, the third would be some hours short of that.† The ancient Greeks had a civil month of thirty days, divided into three weeks each of ten days. The Ahantas of the western districts of the Gold Coast divide the lunar month into three periods or weeks, the first and second of which are of ten days' duration, while the third consists of the remainder of the month. The first period, called *Adae*, is considered lucky; the second, called *Ajain-fo*, unlucky; and the third, called *Adim*, neither lucky nor unlucky. The Yorubas of the Slave Coast of West Africa reckon by nights and moons, and have subdivided the lunar month into six weeks of five days each, or rather, five of them actually contain five days, and the remaining one, which completes the month, about four days and a half. The Javanese week, before the week of seven days was adopted from the Mohammedans, consisted of five days.‡

The Siamese seem, like the Tshi and Gã tribes of West Africa, to have divided the lunar months into four periods of seven days and some odd hours, but, for convenience' sake, they have now made the odd months contain twenty-nine nights and the even months thirty. Their week is commonly said to consist of seven days, but as it is contrived that their sabbath, called *Vampra*, should always fall on the fourth day, and, in the first week of the month, should always be coincident with the fourth night of the moon, it is evident that each week must be of seven days and some hours' duration, or, if three of them are exactly seven days long, then the fourth must complete the lunar month and be eight days and a half long. In dates, the age of the moon, either waxing or waning, is reckoned by evenings, and hence the day of twenty-four hours is considered to begin at sunset.# This, of course, must be the case with all peoples who reckon by moons and nights; and so enduring is custom that the Italians and Bohemians still reckon the day of twenty-four hours from sunset to sunset.

When we tabulate our results, we get the following subdivisions of months, lunar or civil:

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* Johnston, The River Congo, p. 455.

† Astley's Collection, vol. iii, p. 397.

‡ Raffles, History of Java, vol. i, p. 475.

Bock, Temples and Elephants, appendix iii.

The Tshis, Gãs, and probably the Siamese, have four weeks of seven days and three eighths	29⅜ days.
The Ahantas, and probably the Sofalese, have two weeks of ten days, and one week of nine days and a half	29½ "
The modern European method is to count four weeks of seven days	28 "
The Ibos and Congoese have seven weeks of four days	28 "
The ancient Greeks had three weeks of ten days	30 "
The Yorubas have five weeks of five days, and one week of four days and a half	29½ "
The Javanese, and probably the Aztecs, had six weeks of five days	30 "

When we remember that the lunar month is of about twenty-nine days and a half duration, and that twenty-eight and thirty are the nearest numbers to twenty-nine and a half that will divide into an exact number of days, the conclusion is irresistibly forced upon us that with all the above peoples the week was designed to be a subdivision of the lunar month.

The subdivisions of the lunar month would appear generally to mark the phases of the moon. Naturally, the full moon would mark the termination of one subdivision and the commencement of another. Thus, with the Tshis and Gãs, the full moon marks the commencement of the third week of seven days and three eighths, and with the Yorubas the commencement of the fourth week of five days, in each case making the lapse of half a month. Where there is a ten-day week, the full moon is not coincident with the commencement of a week; but the week of ten days, and also that of five, is, like the practice of counting by scores, due to the fact that man has five fingers on each hand, all primitive peoples counting by fingers and toes, or hands and feet.

The Israelites had a week of seven days, and measured time by moons and nights: therefore, from the analogy of other peoples, we conclude that their week was originally a subdivision of a lunar month. When a new moon became visible a new month began, and like the rest of the world they reckoned their day of twenty-four hours from sunset to sunset. They had a lunar year of twelve months, and every two or three years an intercalary month was added to make it agree with solar time. The luni-solar year now used by the Jews was not introduced till 360 A. D.

It is commonly supposed that the week of seven days was invented by the Chaldean astronomers from the seven planets, but though it is beyond question that the days of the week derive their names from the planets, yet it by no means follows that the seven-day period owes its existence to the fact that the astronomers of Chaldea were acquainted with seven celestial bodies which moved. There is, indeed, no connection between alleged cause and effect—no reason why, simply because they knew of

seven planets, they should invent a seven-day measurement of time. In the Chaldean astronomy the planets were arranged in order of magnitude of orbit—that is to say, as follows: Saturn, Jupiter, Mars, the Sun (i. e., the Earth), Venus, Mercury, and the Moon; and if the fact of the planets being seven in number led to the invention of a seven-day period, it is reasonable to suppose that each day would have been named in succession after a planet, and that the order of days would have been as above instead of what it is—viz., Saturn, Sun, Moon, Mars, Mercury, Jupiter, Venus. This order was altogether unintelligible until some clay tablets of the period of Sargon I, about 3800 B. C., which explained it, were exhumed in Chaldea. From these it was learned that each hour of the day of twenty-four hours was consecrated to a planet in the order of magnitude of orbit—viz., Saturn, Jupiter, Mars, etc.—and the day itself received the name of the planet to which the first hour was sacred. Thus, if the first hour of a day were dedicated to Saturn, the eighth, fifteenth, and twenty-second hours would also fall to that planet, the twenty-third to Jupiter, the twenty-fourth to Mars, and the twenty-fifth—that is, the first hour of the next day—to the Sun. In like manner the first hour of the third day would fall to the Moon, that of the fourth to Mars, that of the fifth to Mercury, that of the sixth to Jupiter, and that of the seventh to Venus. This is the explanation of the order of the days of the week, and it appears to be the result of a new idea being grafted on to an old institution—viz., the seven-day week. Before the Chaldeans could consecrate hours to planets, they must have divided their day into hours, and, if they could do this, why could not they perform the much simpler operation of subdividing the lunar month and inventing the week?*

The names, in the Chaldean order, appear to have been introduced into Egypt with the Ptolemaic hypothesis (A. D. 150), and the Romans borrowed them from the Egyptians. Before, however, the Chaldean order was introduced into Egypt, the Egyptians had a seven-day period, and the sixth-seventh day was then sacred to the moon, instead of the third, as under the Chaldean system. In a hymn to Amen-Ra, found in a hieratic papyrus of the fourteenth century B. C., and purporting to be a copy of an earlier document, occurs the following:

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* The Javanese system presents some curious points of resemblance to that of the Chaldeans. When they had a week of five days, each day of twenty-four hours was divided into five periods—viz., from sunset to 8 A. M.; from 8 A. M. to noon; from noon to 3 P. M.; from 3 P. M. to 4 P. M.; and from 4 P. M. to sunset. Each of these divisions was sacred to one of the five gods, Sri, Kala, Wisnu, Maheswara, and Brama, but the order of dedication changed every day. Thus, if the first period of one day were dedicated to Sri, that of the next day was dedicated to Kala, that of the third to Wisnu, and so on. (Raffles, *loc. cit.*)

"O Ra! adored in Aptu (Thebes):
High-crowned in the house of the obelisk (Heliopolis):
King (Ani), Lord of the New-Moon festival:
To whom the sixth and seventh days are sacred." *

Thus, in Egypt, in the fourteenth century B. C., the festival of the new moon was from sunset on the sixth to sunset on the seventh; and since the sixth-seventh of a month was always coincident with a new moon, the Egyptian months must have been lunar months, and their seven-day periods, if true quarters of a lunar month, must have been similar to those of the Tshi and Gã tribes. When, fifteen hundred and fifty years later, the planetary names arranged on the Chaldean system came into use for the days of the week, the Egyptians had adopted a civil month of thirty days, twelve of which, with five supplementary days, completed the solar year; and, as the month had become a civil period no longer connected with the moon, so the week became also a civil period, and was made seven days long exactly.

Among the Romans the first mention of a day named after a planet occurs in the third elegy of the first book of Tibullus, written about B. C. 24, where we find the words "Saturn's unlucky day"; and from Ovid, A. A. i, 415, it is clear that this notion was derived from Palestine. Every seventh day was considered unlucky, but whether the Romans had a civil week, and names for the other days, is uncertain, though the general belief is that they did not adopt the Chaldean seven-day period from Egypt till after the reign of Theodosius, A. D. 395. It is, however, fairly clear that in the early days of their history they reckoned time by half-moons and quarter-moons or lunar weeks. When they had invented civil months, the calends were invariably on the first day of the month, and were so named because the priests had been accustomed to call the people together on that day and announce what days were to be kept sacred during the month. The ides—so called, according to Macrobius (A. D. 400), from the Etruscan verb *iduare*, to divide—were at the middle of the month, either on the thirteenth or fifteenth, and the nones were at the ninth day before the ides, counting inclusively. If the ides fell on the fifteenth, the nones were on the seventh. The days between the calends and nones were called "the days before the nones"; those between the nones and ides, "the days before the ides"; and those from the ides till the end of the month, "the days before the calends." In March, May, July, and October the ides fell on the fifteenth and the nones on the seventh; in the remaining months the ides fell on the thirteenth and the nones on the fifth. Thus the only number that was constant was the number of days

* Records of the Past, vol. ii.

named from the ides, which were always eight—i. e., from the seventh to the fourteenth or from the fifth to the twelfth, while the number of days named from the calends and from the nones varied.

Now, this scheme as a mode of measuring time is so clumsy that we can not suppose it to have come into existence in this shape; it is more probable that it was an old plan which had been adapted to new conditions—viz., the invention of civil months. In 452 B. C. the year consisted of twelve civil months of twenty-nine and thirty days alternately, so as to correspond with the synodic revolution of the moon; and from this it is certain that at some earlier period time was reckoned by lunar months, and civil months had not been thought of. The Roman day, as with all other peoples who reckon by moons, commenced at sunset, for we find that religious festivals always commenced at that hour; the festival of Venus,* for instance, was celebrated on the first three days of April, and began at sunset on the last day of March. When the Romans reckoned by lunar months, the calends would be the day of the new moon, the ides would always correspond with the full moon, and the nones would mark the second quarter. This is simple and intelligible, and the ides would always "divide" the month, for from the day following the moon would begin to wane.† We think, then, that the system of calends, nones, and ides dated from a period when time was reckoned by lunar months, and was really a system of half-moons and quarter-moons, the nones falling on the night of the seventh-eighth, and the ides on that of the fourteenth-fifteenth, which brings us very near to the system of the Tshi and Gã tribes. The introduction of civil months destroyed the connection between the calends, nones, and ides and the phases of the moon; and the lunar week became a civil week of seven days, and finally the names for the days of the week were adopted from Egypt.

From all the foregoing it will now be seen that there is nothing mysterious about the origin of the week, and no need to have recourse to the supernatural to explain it. It is simply a subdivision of a lunar month, and is of four days' duration with some tribes, and five, seven, or ten days' duration among others.

We now come to the question of the origin of sabbaths. We may define a sabbath to be a day sacred to a god, on which it is

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* Ashtoreth, or Astarte, whence the Anglo-Saxon Eostre and Easter.

† The verb *iduare* is probably from the Sanskrit root *indh*, *idh*, to kindle, lighten; whence *indu*, moon; properly, the days of light of the moon (Lewis and Short: art. *Idus*). If so, the word ides would properly be applied to the night of fullest light, that of the full moon; and the meaning "to divide" would be secondary, and would be formed because the ides divided the lunar month.

unlawful for any worshiper of that god to labor. Sabbaths are found everywhere, for it appears to be a general rule throughout the world that gods should have days consecrated to them, and that on those days the followers of those gods may do no work, no matter whether the holy day recurs weekly, monthly, or yearly. The notion appears to be that to refrain from work on a day dedicated to a god is a mode of showing respect. As soon as this view becomes generally accepted, then to work on a holy day is to show want of respect; and as the gods of uncultured peoples are, like uncultured peoples themselves, very sensitive to slights of this nature, the god whose dignity or vanity has been hurt revenges himself by punishing the sabbath-breaker or by punishing his followers at large, because they have not vindicated his honor by punishing the culprit themselves. Then, since to work on the holy day is likely to call down punishment on the individual or on the community, the axiom that it is unlucky to work on that day becomes accepted, and people will not labor or transact business or journey on it.

Bna-da, the second day of the seven-day period of the Tshi tribes, is sacred to the gods of the sea, and is, in consequence, the sabbath of all those who are worshipers of the sea-gods—that is to say, fishermen and those whose vocations take them on the sea. On Bna-da propitiatory offerings are made to the sea-gods, and no one may catch fish. It is the fishermen's day of rest, and, before the colonial government interfered with native customs, any native who violated it by going fishing was put to death, just as was the custom among the Israelites with their own sabbath-breakers (Exodus, xxxi, 14, 15; Numbers, xv, 32). Similarly, the fifth day, Fi-da, is sacred to the gods who preside over agriculture, and is the holy day or sabbath of all persons who cultivate the soil. Here, then, are two cases of sabbaths recurring every seventh day, just as with the Israelites.

The Babylonian Assyrians had the seven-day week and a weekly sabbath. Mr. George Smith says: "In the year 1869 I discovered among other things a curious religious calendar of the Assyrians, in which every month is divided into four weeks, and the seventh days or 'sabbaths' are marked out as days on which no work should be undertaken." * Whether the Assyrian month here referred to was lunar or civil we are not told, but the Rev. A. H. Sayce tells us that, according to the lunar division of the year, "the seventh, fourteenth, nineteenth, twenty-first, and twenty-eighth were days of 'rest,' on which certain works were forbidden," † so that it seems that the Assyrians had subdivided the lunar month in much the same way as the Tshi tribes have.

* Assyrian Discoveries, p. 12.

† Records of the Past, vol. i, p. 164.

As a rule the institution of the sabbath appears to be primarily due to moon-worship, a form of worship which seems to have been almost universal. With all deference to the opinion of that school which fancies it can trace a solar myth in almost every tradition and folklore tale, we think that moon-worship was and is much more general than sun-worship, and for the simple reason that the regular daily recurrence of the sun is far less likely to excite speculation and wonder in uncivilized man than the varying phases and periodical disappearance and reappearance of the moon.

We imagine that the earliest moon sabbath was a monthly festival, held on the day when the new moon was first seen. The Mendis of Sierra Leone abstain from all work on the day of the new moon, alleging that if they infringed this rule the corn and rice would grow red, the day of the new moon being a "day of blood," from which we may perhaps infer that human sacrifices were once offered to the new moon. The Bechuanas of South Africa also observe the day of twenty-four hours, from the appearance of the new moon at sunset till next evening, as a day of rest, and the people refrain from going to their gardens. Neither the Mendis nor the Bechuanas have subdivided the lunar month into weeks, so here we have examples of peoples who reckon time by lunar months and observe a monthly moon sabbath.

If we suppose this to be the first stage, and the lunar month to be subsequently divided into weeks, then it follows that the first day of the first week will be the festival or sabbath of the new moon, as was the case in Sofala. Then, because the first day of the first week is a moon sabbath, it will naturally happen in some cases, through a connection of ideas, that the first day of each week will be dedicated to the moon, and the moon sabbath will recur as often in the month as the latter contains weeks. We have evidence of this among the Tshi and Gã tribes, among whom moon-worship is no longer found, except in so far that the new moon is always saluted with reverence, but that it used to prevail is shown by the moon's epithet *Bohsŭm*, holy, sacred, or deity. Dyo-da, the name of the first day of the Tshi week, means "day of rest," in the sense of a general day of rest for all people, for the moon was worshiped by all classes, and not, like the gods of the sea and agriculture, by special sections of the community only. Dyo-da was a day of rest for everybody, while Bna-da was only a day of rest for seafaring folk and Fi-da for husbandmen. Dsu, the name of the first day of the Gã week, means "purification," and because it was sacred to the moon Dsu seems to have become a title of the moon, for in the cognate Yoruba and Ewe languages we find the moon called Osu and Dsunu respectively, and in Gã itself the word silver is rendered by *dsu-etei*,

moon-substance, or moon-stone. Here, then, are cases of a moon sabbath recurring every seventh day, or four times in a lunar month. Similarly, the first day of the Ibo week of four days is a day of rest, on which no regular work may be done. The first day of the Yoruba five-day week is called *Ako-ojo*, "first day." It is considered unlucky, and no business of importance is ever undertaken on it. On Ako-ojo all the temples are swept out, and it is, properly speaking, a general day of abstention from work, while the other days of the week are only sabbaths for the followers of the gods to which they are dedicated.

When a sabbath recurs every fourth, fifth, or seventh day, the day on which it falls naturally comes in course of time to be called the fourth, fifth, or seventh day, though really properly the first day of the week. Thus Ako-ojo is always called the fifth day, though the words themselves mean "first day." The same change seems to have taken place among the Israelites. On the twenty-ninth day of the moon they began to watch for the new moon, and the day after its appearance was the first day of the new moon or month. Supposing them to have had a seven-day week and a moon sabbath on the day of the new moon, the sabbath would have fallen on the first day of the week, but as people would naturally count from one sabbath to the next, the day after the sabbath would be termed the first day the next, the second, and so on, so that the sabbath itself would come to be called the seventh day. This is, no doubt, the explanation of the sixth-seventh day being sacred to the new-moon festival, as stated in the hymn to Amen-Ra, for the day of the new moon must have been the first day of the lunar month, and also the first day of the week, or subdivision of the lunar month.

Though it is quite possible that the Israelites may have invented a seven-day week and a weekly sabbath spontaneously, like the Tshi and Gã tribes, yet the evidence of the books of the Old Testament goes to show that they borrowed both these institutions from the Babylonian Assyrians during the captivity, and that prior to that epoch they had, like the Mendis, Bechuanas, and Sofalese, only a monthly sabbath, which was the festival of the new moon. No mention of a weekly sabbath is to be found in Joshua, Judges, the books of Samuel, or the first book of Kings. After Deuteronomy, v, 15, no mention of a weekly sabbath is found till we reach II Kings, iv, 23,* and the word sabbath does

* In only two other places in the second book of Kings is it mentioned, viz., xi, 5, and xvi, 18; and, since the older books show that Saul, David, and Solomon knew nothing of a weekly sabbath, we must regard these as interpolations. In II Kings, iv, the Shunamite woman asks her husband to get ready one of the young men and one of the asses, so that she may go to the man of God; and her husband replies (v, 23): "Wherefore wilt thou go to him

not appear either in Psalms or Proverbs. But there is more than a mere omission to mention a weekly sabbath in the old historical books; there is evidence that the institution was unknown, for many occurrences are described by which the weekly sabbath, had it existed, must have been violated. Jericho was encompassed for seven days in succession, which must, therefore, have included one weekly sabbath (Joshua, vi, 13–16). During the events narrated in I Samuel, xxix and xxx, David was on the march for twelve days in succession, without any day of rest being observed; and, since Solomon gave a feast to the people of Israel which lasted fourteen days (I Kings, viii, 65, and II Chronicles, vii, 9), and so must have included two sabbaths, he could have known nothing of the injunction that on the sabbath every man was to abide in his own place (Exodus, xvi, 29). Elijah must likewise have broken the rest of several weekly sabbaths (I Kings, xix, 7, 8). In the article on Marriage and Kinship among the Ancient Israelites * we gave several valid reasons for supposing that the Levitical law was not compiled till about the period of the Babylonian captivity, and this ignorance of the institution of the weekly sabbath on the part of those who must have known about it, had it existed, is an additional reason. We can not suppose that the sabbath rest was willfully broken, for its violation was considered so grave a crime as to be punished with death.

But, while there is a complete silence on the subject of the weekly sabbath in the books we have mentioned, we find moon-worship and the festival of the new moon referred to in more than one place. The passages in I Samuel, xx, 5, 18, 24, and 26 clearly refer to a new-moon festival. Psalm lxxxi, 3, is explicit; it runs: "Blow up the trumpet in the new moon, in the time appointed, on our solemn feast day." Proverbs, vii, 19, 20, implies that the day of the new moon was a day of rest: "For the good man is not at home, he is gone a long journey: he hath taken a bag of money with him, and will come home at the new moon." The passage in Job, xxxi, 26, 27—"If I beheld the sun when it shined, or the moon walking in brightness, and my heart hath been secretly enticed, or my mouth hath kissed my hand"—shows that moon-worship was known, and, according to II Kings, xxi, 3, 5, and xxiii, 5, it was practiced by some of the kings of Judah. Indeed, a new-moon festival could only originate with moon-worship.

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to-day? It is neither new moon nor sabbath." This implies that it was only customary to visit "men of God" on such days; but in Exodus, xvi, 29, we find the injunction, "Let no man go out of his place on the seventh day." The word sabbath in this case must, therefore, either be a later addition to the text, or refer to a holy day different from the sabbath ultimately adopted.

* Popular Science Monthly, January, 1893.

From all this we infer that before coming in contact with the Babylonian Assyrians the Israelites had no weekly sabbath or day of rest recurring every seventh day, but had a festival of the new moon on the first day of the lunar month (I Samuel, xx, 27), which, as we shall show, was observed by them as a day of rest, as it is by other peoples at the present day. After they had adopted the weekly sabbath from the Babylonians, they endeavored, through national vanity, to show that they had always observed it, and to account for it they inserted in their books two traditions of its origin which are fatally at variance. Exodus, xx, 10, 11, says: "For in six days Jahveh made heaven and earth, the sea, and all that therein is, and rested the seventh day; wherefore Jahveh blessed the sabbath day, and hallowed it"; while in Deuteronomy, v, 15, we read: "And remember thou wast a servant in the land of Egypt, and that Jahveh, thy God, brought thee out thence through a mighty hand and a stretched-out arm: therefore Jahveh, thy God, commanded thee to keep the sabbath day."

In the later books, written after contact with the Babylonians, we find sabbaths frequently mentioned and strongly insisted upon, but nearly always in connection with new moons. Thus, in Nehemiah, x, 33, we read, "For the continual burnt offering, of the sabbaths, of the new moons"; in Isaiah, i, 13, "The new moons and sabbaths"; in Isaiah, lxvi, 23, "And it shall come to pass that from one new moon to another, and from one sabbath to another, shall all flesh come to worship before me, saith Jahveh"; in Ezekiel, xlv, 17, "In the feasts, and in the new moons and in the sabbaths"; and in Hosea, ii, 11, "Her feasts, her new moons, and her sabbaths." New moons and sabbaths are also mentioned together in I Maccabees, x, 24; I Esdras, v, 32, and in Judith, viii, 6. In Ezekiel, xlvi, i, we read that the gate of the inner court of the temple was to "be shut the six working days," and opened on the sabbath and the day of the new moon, which shows that the latter was a day of rest. The offering to be made on the day of the new moon was superior to that to be made on the sabbath (v, 4, 5). In Amos, viii, 5, we read: "When will the new moon be gone, that we may sell corn, and the sabbath, that we may set forth wheat?" which again shows that the day of the new moon was a day of rest.*

In no one of these passages is the new-moon festival spoken of as inferior in importance to the sabbath. On the contrary, since the offering was superior, it is to be presumed that the festival was also superior. Each was a day of rest. The explanation doubtless is that, while adopting a seventh-day sabbath from the

* New moons are mentioned alone—that is, without sabbaths—in Ezra, iii, 5. Ezra does not anywhere mention the sabbath.

Babylonians, the Israelites retained their old monthly sabbath, or festival of the new moon, and considered it to be the more important because the more ancient and national. Whether the monthly sabbath was coincident with the first weekly sabbath would depend upon whether the seven-day week, as borrowed from the Babylonians, was a civil period or a true subdivision of a lunar month. That the Israelites did borrow the weekly sabbath from the Babylonians there can scarcely be any doubt. We know that the Babylonians observed the seventh day as a day of rest, and the historical books of the Old Testament show that the Israelites had no knowledge of any such observance till after contact with Babylon.*

TWO LUNG-TESTS.

By F. L. OSWALD.

WHEN the would-be reformer Balmaceda ended his blighted career, a correspondent of the Chili Mercurio consoled himself with the thought that "the ruin of his friend, though in some respects an irreparable loss, had at least an experimental value."

A similar reflection may reconcile American naturalists to the fate of Pat Rooney, the champion chimpanzee of the Cincinnati Zoo. It will be a long time before the pet dealers of this continent get hold of another such marvel, but the manner of his death proves at least the impossibility of preventing lung disorders by habitual indoor life.

Pat's prison was in many respects a model of comfort. He had a rocking-chair and a variety of gymnastic contrivances, a bench and a dinner-table of his own, and could rely on a liberal allowance of well-selected food, served daily at convenient hours. The cage was large enough for extensive romps, and was kept as

* The sabbath is not, as has been said, anywhere mentioned between Deuteronomy, v, 15, and II Kings, iv, 23, but it is mentioned in Chronicles, which refers to some of the same periods. Chronicles is, however, clearly a compilation from the other books, for it contains genealogies from Genesis, and some of the same occurrences as are narrated in Samuel and Kings. The word sabbath occurs in the following passages: I Chronicles, ix, 32, where certain Levites are appointed to prepare the shew-bread every sabbath. This chapter describes the Israelites as dwelling in Jerusalem in the days of Saul, which we know, from II Samuel, v, 5–9, was not the case. In I Chronicles, xxiii, 31, David appoints Levites to offer sacrifices on sabbaths and new moons; in II Chronicles, ii, 4, Solomon says he built the temple for the burnt offerings on the sabbaths and new moons; and in II Chronicles, xxxi, 3, Hezekiah appoints his portion for burnt offerings for the sabbaths and new moons. These are the only cases in which the sabbath is mentioned, and the combinations of sabbaths with new moons, only found in the later books, is additional proof, if further proof be required, that the two books of Chronicles date from post-captivity times.

clean as the model nurseries of the Faubourg St.-Martin. Realizing the disadvantage of a man-ape being alone, the directors of the Zoo had even contrived to get him a helpmeet of his own tribe and age. A wire screen prevented the introduction of improper comestibles—a paradise exempted from the temptation of forbidden fruit.

But the benefit of all these arrangements was neutralized by the same mistake that has doomed millions of city children to a consumptive's grave—an excess of precaution in the exclusion of cool air currents. The entire cage had been inclosed with double sheets of plate glass.

Warm air was introduced by means of register pipes, and a small aperture at the top of the cage established communication with the atmosphere of a hall, which in its turn was roofed and artificially warmed, thus enabling the warden to keep the temperature of the ape prison in a state of uniformity far exceeding that of the equatorial regions. In the forests of the lower Congo the thermal extremes range from 105° F. at 2 P. M. to 55° after a midnight rainstorm, a difference of fifty degrees, but an apparent contrast (allowing for the sudden transition from brooding heat to the blasts of a drenching gale) of something more like eighty degrees.

From October to June, Mr. Rooney's glass house was rarely permitted to get colder than 60°, the average being about 75° and the maximum 80°. In midsummer it got, of course, much warmer, but the supposed delicate constitution of the guest from the tropics was made an argument against every proposition to let him share the romps of his fellow fourhanders in the open-air extension of their cages.

At the time of his arrival at the Zoo, Mr. Rooney attested the soundness of his lungs by gymnastic exploits rarely rivaled outside of a Japanese circus, and seemed indeed almost insensible to fatigue. With one hand, or the finger tips of both hands, clutching the horizontal bar, he would whirl around in a circle till the spectators got dizzy in watching his evolutions. He would turn somersaults all around the walls of his gymnasium, rising higher and higher with every turn, till a climax swing landed him on top of his trapeze, where he would squat with his arms akimbo and with tightly compressed lips, suggesting abundant reserve stores of air in his capacious chest.

But at the end of the third year it was noticed that the self-taught acrobat was getting less active, and about the middle of last summer it could no longer be doubted that his health had been affected in some way or other. His appetite became capricious; there were days when he contented himself with nibbling small samples of his dinner, though an hour later he was apt to

swallow substances which no self-respecting chimpanzee would have touched with the tip of his tongue. Instead of noticing the improvements of his gymnasium, he would turn over on his side and stare into the darkest corner of his den for hours together, with the perversity of a fourhanded Schopenhauer, resolved to see only the shady side of things. On extra warm days he became restless, running to and fro as if under the impulse of some unsatisfied desire, or watch the playground of his privileged neighbors like an orphan boy viewing the forbidden paradise through the bars of a poorhouse window, and wondering how he came to deserve his sad predicament. At such times the invalid's face, indeed, often assumed an expression more pathetically human than anything ever observed in his fits of mimicry; he looked haggard and contemplative, but his appearance was ascribed to gastric causes—some transient indigestion, brought on by his dietetic aberration. Yes, it must be dyspepsia; it seemed impossible, with such precautions against cold, that he could have contracted a disorder of the lungs. Were not the glass plates fitted tight all around, almost like the walls of an aquarium? And were they not double?

The sick half-brother sighed when sympathetic visitors crowded around his sweatbox; he evidently guessed their benevolent intentions, but some instinct seemed to tell him that his complaint had passed the remediable stage. Once, in October, and again in January, during a spell of bracing, clear cold weather, the flickering flame burned a little brighter, but the progress of emaciation continued, till the deliquium of the knee-muscles and an almost total loss of appetite marked the beginning of the end. One afternoon Pat astonished his keeper by declining his brandy ration. He sniffed it, but turned away with disgust, looking "life-weary," as a local journalist expressed it, "and anxious to leave a world where a monkey without a tail can not hope to get a fair chance anyhow."

The next morning those expressive eyes had faded into a blind stare, and the directors of the Zoo invited a number of medical men to attend the autopsy. All sorts of diagnostic theories had been advanced, but the first slit through the pleura set those controversies at rest. "Gentlemen, I was mistaken," said the officiating surgeon; "I'm no monkey-doctor: Pat Rooney is just a mass of tubercles."

About the same time when the champion chimpanzee made his *début* at Cincinnati, Ohio, a southern railway official brought a pair of Mangaby apes to Old Fort, North Carolina. They had originally been intended as a present to a resident of Asheville, in the adjoining county, but the addressee having intimated his aversion to zoölogical side shows, the importer sent them to his

own home, and after trying in vain to procure a ready-made cage of sufficient size, lodged his guests in a garden house on a hill overlooking the Old Fort railway depot.

Old Fort, near the upper or west end of McDowell County, must have an elevation of at least two thousand feet above sea level. The proximity of Mitchell's Peak has made the little town something of a summer resort, even the dog days being pleasantly cool, but the winter temperature deserves a chillier name, and the railway to Asheville has more than once been blockaded by snow-drift. The locality, in fact, can hardly claim the climate of a perennial pleasure resort for visitors from the African tropics, but Captain T——'s guests were overjoyed to exchange their narrow traveling cage for a roomy pavilion with lattice walls admitting breezes from every quarter of the compass.

In that playground of all the mountain winds the two four-handers have romped about year after year, as happy as hawks in a tower roost, and free from the slightest symptoms of lung disorders.

"Does your brother ever wash himself?" a friend of mine asked the junior relative of a Tennessee ragamuffin. "Yes, sometimes on Sunday," said the youngster; and sometimes on holidays the litter at the bottom of the garden house is raked out and a bundle of clean straw flung in. The bill of fare is what the vegetarians call a "compromise diet"—frugal on the whole, but varied with eggs, hash, and occasional remnants of pork and cheese. Fragments of tobacco, and flasks suggesting the surreptitious visits of contrabandists from the highlands, are now and then found in the litter, but mountain air, like Count Tolstoi's atonement of labor, cancels the debt of such peccadillos. The native land of the Mangaby (*Cercocebus fuliginosus*) is the coast plain of Loango, north of the Congo valley, and immediately south of the equator, and, with the exception of the Gaboon delta, about the most sultry-hot region of the African continent. Captain T——'s pets were not born in captivity, but shipped directly from the mouth of the Congo to New York city, and from New York to western North Carolina, where they arrived in September—i. e., with hardly two months' time for acclimatization to a country with the winter isotherms of northern Maryland. In stress of storms they do now and then avail themselves of their straw bed, but in calm, frosty nights they stick to their top perch with the obstinacy of a pillar saint. The Mangaby is irascible to a grotesque degree, and the mischievous pranks of the local youngsters often throw the two exiles into a delirium of rage that can not fail to aggravate the debilitating effects of confinement and uncongenial food, but an abundant supply of pure (though often ice-cold) air has turned the scales against all these

disadvantages, and the two Africans in their lattice prison are to-day probably the stoutest fourhanders with an equal record of long captivity in any country of the temperate zone.

The calorific ingredients of their diet may help them to survive the long winter nights, but a female baboon which escaped from a private menagerie in the neighborhood of Tallulah Falls, Georgia, in the fall of 1886, accomplished the same feat on a *menu* of grass seeds and persimmons, and during a heavy snowfall in December starved like a Mexican school teacher rather than run the risk of forfeiting the luxury of freedom by approaching a farmstead. She was recaptured by a hunter, or rather by his hounds, the next month, but fought like a catamount, and her second escape in March caused an excitement as if the chained beast of the Apocalypse had broken loose. Her peculiar tracks in the snow and in the sand of the river shore (where she used to turn over flat stones in quest of crawfish) often put hounds on her trail, but she always contrived to reach "tall timber" ahead of her pursuers, till she met her Waterloo during a sleet-storm in April, when the combined effects of cold and hunger had modified the prehensile vigor of her four hands. The hounds killed her and ripped her shaggy coat into shreds, but dissection revealed the fact that her lungs were almost as sound as those of a mountain buck, the only mementos of her confinement being three small cysts of atrophied tubercles.

In his native haunts the chimpanzee rivals the vigor of any fourhanded or fourfooted creature of his size, and there can be no doubt that the secret of his failure to survive removal to the higher latitudes is not his sensitiveness to cold air currents, nor his impatience of confinement, but his *expensiveness*, and the consequent reluctance of his jailers to expose him to atmospheric influences which would save his life, but which a deep-rooted delusion still dreads as the harbinger of death.

More than fifty years ago Dr. Friedberger, of Vienna, appears to have suspected that relation of cause and effect in the case of the Duke of Reichstadt, the son of the first Napoleon.

"You have saved so many consumptives," said one of the doctor's colleagues, "don't you see any chance to help poor R.?"

"It's a sadly peculiar case," said the specialist; "as an ordinary mortal he might pull through, but as the son of a demigod I fear he is doomed."

"What! do you think the Government would—"

"Oh, hush! No such idea. But, you see, his life is extra valuable, and for that very reason his ill-advised friends are extra strict in the enforcement of the precautions that will stifle his vital vigor."

STUDIES OF CHILDHOOD.

V.—PSYCHOLOGICAL AND THEOLOGICAL IDEAS.

By JAMES SULLY, M. A., LL. D.,
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WE may now pass to some of the characteristic modes of child-thought about that standing mystery, the self. There is reason to suppose that a good deal of terribly earnest thinking goes on in the childish head respecting the problem of "my" nature, "my" existence, "my" origin.

The date of the first thought about self, the first dim self-awareness, probably varies considerably in the case of different children according to rapidity of mental development and circumstances. The little girl who was afterward to be known as George Sand may be supposed to have had an exceptional development, and the accident to which she refers as having aroused the earliest form of self-consciousness was, of course, exceptional too. There are probably many robust and dull children, knowing little of life's misery, and allowed in general to have their own way, who have little more of self-consciousness than that, say, of a young, well-favored, well-supplied porker.

The earliest idea of self seems to be obtained by the child through an examination with the senses of touch and sight of his own body. A child has been observed to study his fingers attentively in the fourth and fifth months, and this scrutiny goes on all through the second year and even into the third.* Children seem quite early to be impressed by the fact that in laying hold of a part of their body with a hand they get a different kind of experience from that which they obtain when they grasp a foreign object. Through these self-graspings, self-strikings, self-bitings, aided by the very varied and often extremely disagreeable operations of the nurse and others on the surface of their bodies, they probably reach during the first year a dim idea that their body is different from all other things, is "me" in the sense that it is the living seat of pain and pleasure. The growing power of movement of limb, especially when the crawling stage is reached, gives a special significance to the body as that which can be moved, and by the movements of which interesting and highly impressive changes in the environment—e. g., bangs and other noises—can be produced.

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* For the facts see Preyer, Die Seele des Kindes, cap. xxii. Tracy, The Psychology of Childhood, p. 47.

It is probable that the first ideas of the bodily self are ill-defined. It is evident that the head and face are not known at first as a *visible* object. The upper extremities, by their movement across the field of vision, would come in for the special notice of the eye. We know that the baby is at an early date wont to watch its hands. On the other hand, the lower limbs seem to receive special attention from the exploring and examining hand.

There is some reason to think, however, that in spite of these advantages the limbs form a less integral and essential part of the bodily self than the trunk. A child in his second year was observed to bite his own finger till he cried with pain. Preyer tells us of a boy of nineteen months who, when asked to give his foot, seized it with both hands and tried to hand it over. The Worcester collection of children's thoughts has a story of a child of three years and a half who, on finding his feet stained by some new stockings, observed, "O mamma, these ain't my feet, these ain't the feet I had this morning!" On the other hand, the boy C—— spoke of his limbs as foreign objects coming in the way of himself—that is, his body.

Probably different influences combine to give this importance to the trunk in the child's conception of the bodily self. The trunk is the larger portion; it is stationary, always at hand, whereas the hands and feet come and go, and may disappear for some time. Much more important, I suspect, is the fact that the child soon begins to localize in a vague way in the trunk the most frequent and important of his feelings of comfort and discomfort, such as the pains of impeded respiration and digestion and the corresponding reliefs. We know that the "vital sense" forms the sensuous basis of self-consciousness in the adult, and it is only reasonable to suppose that in the first years of life, when it fills so large a place in consciousness, it has most to do with determining the idea of the sentient or feeling body. Afterwards the observation of maimed men and animals would confirm the idea that the trunk is the seat and essential portion of the living body. The language of others, too, by identifying "body" and "trunk," would strengthen the tendency.

About this interesting trunk-body and what is inside it, the child speculates vastly. References to bones, stomach, and so forth have to be understood somehow. It would be interesting to get at a child's unadulterated view of his anatomy.

At a later stage of the child's development, no doubt, when he comes to form the idea of a conscious thinking self, the head will become a principal portion of the bodily self. In the evolution of the self-idea in the race, too, we find that the soul was lodged in the trunk long before it was assigned a seat in the head. As is illustrated in C——'s case, children are quite capable of forming

a double idea of their bodily self, the trunk and limbs which may die and be put in the ground, and the head the seat of the soul which lives on and passes into heaven. But of this more later on. Nay, more. A child may indulge the fancy—playfully, at least—that the several parts of the body are so many different bodily selves. Laura Bridgman would amuse herself by spelling a word wrong with one hand, slap that hand with the other, and then proceed to spell it right, laughing at her game. Here the offending hand was for the moment personified and given a sort of independent existence.

Very interesting in connection with the formation of the idea of self is the experience of the mirror. It would be absurd to expect a child when first placed before a mirror to recognize his own face. He will smile at the reflection as early as the tenth week, though this is probably merely an expression of pleasure at the sight of a bright object. If held in the nurse's or father's arms to a glass when about six months old, a baby will at once show that he recognizes the image of the familiar face of the latter by turning round to the real face, whereas he does not recognize his own. He appears at first and for some months to take it for a real object, sometimes smiling as to a stranger or even kissing it, and then trying to grasp it with the hand, turning up the glass or putting his hand behind it in order to see what is really there. Darwin has shown that monkeys behave very much in the same way before a mirror. Little by little he gets used to it, and then, by noting certain agreements between his bodily self and the image, as when he notices the reflection of his pinafore or of the movement of his hands as he points—partly, no doubt, by a kind of inference of analogy from the doubling of other things by the mirror—he reaches the idea that the reflection belongs to himself. By the sixtieth week Preyer's boy had associated the name of his mother with her image, pointing to it when asked where she was. By the twenty-first month he did the same thing in the case of his own image.*

An infant will, we know, take a shadow to be a real object and try to touch it. Some children, on first noticing their own and other people's shadows, are afraid as at something uncanny. Here, too, in time the strange phenomenon is taken as a matter of course and referred to the sun.

We know that the phenomena of reflections and shadows, along with those of dreams, had much to do with the development, in the primitive thought of the race, of the animistic conception that everything has a double nature and existence. Do

* See the very full account of the mirror experiment in Preyer's book (3te Auflage), p. 459 *et seq.*

children form similar ideas? We can see from the autobiography of George Sand how a clever girl, reflecting on the impressive experience of the echo, excogitates such a theory of her double existence; and we know, too, that the boy Hartley Coleridge distinguished among the "Hartleys" a picture Hartley and a shadow Hartley. I have not, however, discovered that children are given to working out and seriously believing a theory of the multiple existence of themselves and other things.

The prominence of the bodily pictorial element in the child's first idea of self is seen in the tendency to confine personal identity within the limits of an unchanged bodily appearance. The child of six, with his shock of curls, refuses to believe that he is the same as the hairless baby whose photograph the mother shows him. How different, how new a being a child feels on a Sunday morning after the extra weekly cleansing and brushing and draping! The bodily appearance is a very big slice of the content of most people's self-consciousness, and to the child it is almost everything.

But in time the conscious self which thinks and suffers and wills comes to be dimly discerned. I have long thought, and nothing that I have read in the way of argument against the idea has shaken my belief, that a real advance toward this true self-consciousness is marked by the appropriation and use of the different forms of language, "I," "me," "mine."*

As long as the bodily aspect is uppermost in the idea of self, so long is it natural for the child to speak of himself in the third person by his proper name, as he would speak of any other object of perception. The use of the first person seems to mark a clearer distinction of the *ego* as subject from its polar opposite the world of objects, and this manifestly involves true self-reflection as distinguished from self-perception—i. e., perception and recognition of the bodily self.

Sometimes the apprehension of a hidden self distinct from the body comes as a sudden revelation, as to little George Sand. Such a swift awakening of self-consciousness is apt to be an epoch-making and memorable moment in the history of the child.

A father sends me the following notes on the development of self-consciousness: "My girl, three years old, makes an extraordinary distinction between her body and herself. Lying in bed, she shut her eyes and said, 'Mother, you can't see me now.' The mother replied, 'Oh, you little goose, I can see you, but you can't see me.'

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* Preyer argues that the child does not at first hear "I," "me," etc., the nurse and mother speaking to him in the third person: "Nurse says so," "Roland must be good," etc. Exactly. But why do the mother and others make the change about this time, and begin to say I and you? Is it not precisely because the child is making the advance, and showing that he can understand the language of adults?

To which she rejoined, 'Oh, yes, I know you can see *my body*, mother, but you can't see *me*.'" This child about the same time was concerned about the reality of her own existence. One day, playing with her dolls, she asked her mother, "Mother, am *I* real, or only a pretend like my dolls?" Here, again, it is plain, the emphasis was laid on something non-corporeal, something that animated the body, and not a mere bit of mechanism put inside it. Two years later she showed a still sharper intellectual differentiation of the visible and the invisible self. Her brother happened to ask her what they fed the bears on at the Zoo. She answered impulsively, "Dead babies and that sort of thing." On this the mother interposed, "Why, F——, you don't think mothers would give their dead babies to the animals?" To this she replied: "Why not, mother? It's only their bodies. I shouldn't mind your giving mine." It is worth noting that this was the same girl who about the same age took compassion on the poor autumn leaves dying on the ground. Her mind was plainly brooding at this time on the conscious side of existence.

The mystery of self-existence has probably been a puzzle to many a thoughtful child. A lady, a well-known writer of fiction, sends me the following recollection of her early thought on this subject: "The existence of other people seemed natural; it was the 'I' that seemed so strange to me. That I should be able to perceive, to think, to cause other people to act, seemed to me quite to be expected, but the power of feeling and acting and moving about myself, under the guidance of some internal self, amazed me continually."

It is, of course, hard to say how exactly the child thinks about this inner self. It seems to me probable that, allowing for the great difference in reflective power, children in general, like primitive man, tend to materialize it, as indeed we all can not help doing, thinking of it dimly as a filmlike, shadowlike likeness of the visible self. The problem is complicated for the child's consciousness by religious instruction with its idea of an undying soul.

As may be seen in the recollections just quoted, this early thought about self is greatly occupied with its action on the body. Among the many things that puzzled the much-questioning little lad already frequently quoted was this: "How do my thoughts come down from my brain to my mouth, and how does my spirit make my legs walk?" C——'s sister, when four years and ten months old, wanted to know how it is we can move our arm and keep it still when we want to, while the curtain can't move except somebody moves it. The first attempts to solve the puzzle are of course materialistic, as may be seen in our little questioner's delightful notion of thoughts traveling through the body and out at the mouth.

Very curious are the directions of the first thoughts about the past self. The idea of personal identity so dear to philosophers does not appear to be fully reached at first. On the contrary, in the case of the boy C——, the past self was divorced from the present under the image of the opposite sex in the odd expression "When I was a little girl." This idea I find is not confined to C——. Another little boy when about three years and a half old asked his mother, "Was I a girl when I was small?" and the little questioner whom I have called our zoölogist was also accustomed to say, "When I was a ickle dirl" (girl). But, funnily enough, this same little boy would also say, "When I was a big man," to describe the state of things long long ago. What does this mean? Is the child apt to think of his life as a series of transformations, of transitions from littleness to bigness and the reverse, and even of transmutation from the one sex into the other? And if so, how does he come by this odd view of life? It seems probable to me that to the child's lively fancy such metamorphoses of the self present themselves as easy and natural. Is not much of his time passed in fancying himself transformed by some wondrous magic into a prince, a fairy, and what not? It may be hard to trace out all the little misapprehensions of language, all the quaint childish inferences, which lie behind such thoughts as these. It is possible, however, after all, that the child does not mean to be taken too literally in this talk about his past self. The little boy's reference to his past girlhood or bigness may be only his bold, figurative way of trying to express the idea of a state very, very different from the present, a phase of his existence which he can not join on to the later and nearer, and which he is forced to regard as another existence.

The difficulty to the child of conceiving of his remote past is surpassed by that of trying to understand the state of things before he was born. The true mystery of birth for the child, the mystery which fascinates and holds his mind, is that of his beginning to be. This was illustrated in C——'s question: "Where was I a hundred years ago? Where was I before I was born?" It remains a mystery to all of us, only that after a time we are wont to put it aside. The child, on the other hand, is stung, so to say, by the puzzle, his whole mind being thrown into energetic movement.

It is curious to note the differences in the attitude of children's minds toward the mystery. The small person accustomed to petting, to be made the center of others' thought and action, may be struck with the blank in the common home life before his arrival. A lady was talking to her little girl H——, aged three years, about something she had done when she was a child. H—— then wanted to know what she was doing then, and was told by her mother,

"Oh, you were not here at all." She seemed quite amazed at this, and said: "And what did you do without H——? Did you cry all day for her?" And being informed that this was not the case, she seemed quite unable to realize how her mother could have existed without her. There is something of the charmingly naive egoism of the child here, but there is more, there is the vague expression of the unifying integrating work of love. Lovers, one is told, are wont to think in the same way about the past before they met and became all in all to one another. For this little girl, with her strong sense of human attachment, the idea of a real life without that which gave it warmth and gladness was a contradiction.

Sometimes, again, in the more metaphysical sort of child-head, the puzzle relates to the existence of the outer world of things. We have all been perplexed by the thought of the world's existing before we were, and going on to exist after we cease to be; though here, again, save in the case of the philosopher, perhaps, we get used to the puzzle. Children may be deeply impressed with this apparent contradiction. Jean Ingelow, in her interesting reminiscences, thus writes of her puzzlings on this head: "I went through a world of cogitation as to whether it was really true that anything had been and lived before I was there to see it. . . . I could think there might have been some day when I was very little—as small as the most tiny pebble on the road—but not to have been at all was so very hard to believe." A little boy of five, who was rather given to saying smart things and what looked like a display of his powers, was one day asked by a visitor, who thought to rebuke what she took to be his conceit, "Why, M——, however did the world go round before you came into it?" M—— at once replied: "Why, it *didn't* go round. It only began five years ago." Was this, as perhaps nine persons out of ten would say, merely a bit of dialectic smartness, the evasion of an awkward question by denying the assumed fact? I am disposed to think that there was more, that the virtuous intention of the visitor had chanced to discover a hidden child-thought, for the child is naturally a Berkeleyan, in so far at least that for him the reality of things is reality for his own sense-perceptions. A world existent before he was on the spot to see it seems to the child's intelligence a contradiction. M——'s expression, "It only began five years ago," was merely a particularly audacious way of putting an idea which lurks, I suspect, in the dim region of many little minds that try to think about things.

Children will sometimes use theological ideas as an escape from this puzzle. The myth of babies being brought down from heaven is particularly helpful. The quick young intelligence sees in this pretty idea a way of prolonging his existence back-

ward. The same little boy that was so concerned to know what his mother had done without him happened one day to be passing a street pump with his mother, when he stopped and observed with perfect gravity, "There are no pumps in heaven where I came from." He had evidently thought out the fiction of the God-sent baby to its logical consequences, and after taxing in vain his prenatal memory had arrived at the conclusion that pumps were not of heaven's furniture.

Children appear to have very vague ideas about the past. On the one hand, as in the case of their measurements of space, their standard of time is not ours; an hour, say the first morning at school, may seem an eternity to a child's consciousness. The days, the months, the years seem to fly faster and faster as we get older. On the other hand, as in the case of space-judgment, too, the child, through his inability to represent time on a large scale, is apt to bring the past too near the present. Mothers and young teachers would be surprised if they knew how children interpreted their first historical instruction introduced by the common phrase "Many years ago," or similar expressions. Here is an illustrative anecdote sent in by the aunt of the child, a boy of five years and a half: "H—— was beginning to have English history read to him, and had got past the 'Romans,' as he said. One day he noticed a locket on my watch chain, and desired that it should be opened. It contained the hair of two babies both dead long before. He asked about them. I told him they died before I was born. 'Did father know them?' he asked. 'No, they died below *he* was born.' 'Then who knew them and when did they live?' he asked, and as I hesitated for a moment, seeking how to make the matter plain, 'Was it in the time of the Romans?' he gravely asked." The odd-looking historical perspective here was quite natural. He had to localize the babies' existence somewhere, and he could only do it conjecturally by reference to the one far-off time of which he had heard, and which presumably covered all that was before the lifetime of himself and of those about him.

We may now pass to another group of children's ideas—a group already alluded to—those which have to do with the invisible world, with death and what follows, with God and heaven. Here we find an odd patchwork of thought, the patchwork-look being due to the heterogeneous sources of the child's information, his own observations of the seen world on the one hand and the ideas supplied him by what is called religious instruction on the other. The characteristic activity of the child-mind, so far as we can disengage it, is seen in the attempt to co-ordinate the disparate and seemingly contradictory ideas into something like a coherent system.

Like the beginning of life, its termination, death, is one of the recurring puzzles of childhood. This might be illustrated from almost any autobiographical reminiscences of childhood. Here, indeed, the mystery is made the more impressive and recurrent to consciousness by the element of dread. A little girl of three years and a half asked her mother to put a great stone on her head, because she did not want to die. She was asked how a stone would prevent it, and answered with perfect childish logic, "Because I shall not grow tall if you put a great stone on my head, and people who grow tall get old and then die."

Death seems to be thought of by the unsophisticated child as the body reduced to a motionless state, devoid of breath and unable any longer to feel or think. This is the idea suggested by the sight of dead animals, which but few children, however closely shielded, can escape.

The first way of envisaging death seems to be as a temporary state like sleep, which it so closely resembles. A little boy of two years and a half, on hearing from his mother of the death of a lady friend, at once asked, "Will Mrs. P—— still be dead when we go back to London?"

The knowledge of burial leads the child to think much of the grave. The instinctive tendency to carry on the idea of life and sentience with the buried body is illustrated in C——'s fear lest the earth should be put over his eyes. The following observation from the Worcester collection illustrates the same tendency: "A few days ago H—— (aged four years and four months) came to me and said, 'Did you know they'd taken Deacon W—— to Grafton?' I, 'Yes.' H——: 'Well, I s'pose it's the best thing. His folks' (meaning his children) 'are buried there, and they wouldn't know he was dead if he was buried here.'" This reversion to savage notions of the dead in speaking of a Christian deacon has its humorous aspect. It is strange to notice here the pertinacity of the natural impulse. All thoughts of heaven were forgotten in the absorbing interest in the fate of the body.

Do children, when left to themselves, work out a theory of another life, that of the soul away from the dead deserted body? It is of course difficult to say, all children receiving some instruction at least of a religious character respecting the future. One of the clearest approaches to spontaneous child-thought that I have met with here is supplied by the account of the Boston children. "Many children," writes Prof. Stanley Hall, "locate all that is good and imperfectly known in the country, and nearly a dozen volunteered the statement that good people, when they die, go to the country—even here from Boston." The reference to good people shows that the children are here trying to give concrete definiteness to something that has been said by another. These

children had not, one suspects, received much systematic religious instruction. They had perhaps gathered in a casual way the information that good people, when they die, are to go to a nice place. Children pick up much from the talk of their better-instructed companions which they only half understand. In any case it is interesting to note that they placed their heaven in the country, the unknown beautiful region where all sorts of luxuries grow. How like the idea of the happy hunting grounds to which the American Indian consigns his dead chief! One would have been glad to examine these Boston children as to how they combined this belief in going to the country with the burial of the body in the city.

In the case of children who pick up something of orthodox religious creed the idea of going to heaven has somehow to be grasped and put side by side with that of burial. How the child-mind behaves here it is hard to say. It is probable that there are many comfortable and stupid children who are not troubled by any appearance of contradiction. As we saw in the remark of the American child about the deacon, the child-mind may oscillate between the indigenous idea that the man lives on in a sense underground and the imported idea that he has passed into heaven. Yet undoubtedly the more thoughtful kind of child does try to bring the two ideas into agreement. The boy C—— attempted to do this first of all by supposing that the people who went to heaven (the good) were not buried at all; and later by postponing the going to heaven, the true entrance being that of the body by way of the tomb. Other ways of getting a consistent view of things are also hit upon. Thus a little girl of five years, probably starting from the knowledge that it is the body—which she interpreted as the trunk—which is put under ground, and perhaps following the hint given by a drawing of cherub heads, thought that the *head* only passed to heaven. A little boy of six, reflecting the early process of human thought as still registered in such words as spirit (cf. πνεῦμα), held that God took the *breath* to heaven.

In what precise manner children imagine the entrance into heaven to take place I do not feel certain. The legend of being borne by angels through the air probably assists here. It has been suggested to me that the theory entertained by many children that old people shrink and become of the size of children is connected with this thought about going to heaven. Just as we arrive on earth as babies in the arms of angels, so growing small again we are carried back from earth to heaven. This may be so in certain cases, although some of my facts show that the child thinks of old people as getting small without any direct reference to death.

Coming now to ideas of supernatural beings, it is to be noted

that children do not wholly depend for their conceptions of these on religious or other instruction. The liveliness of their imagination, and their impulses of dread and trust, push them on to a spontaneous creation of invisible beings. In C——'s haunting belief in the wolf, we see a sort of survival of the tendency of the savage to people the unseen world with monsters in the shape of demons. Another little boy of rather more than two years old who had received no religious instruction acquired a similar haunting dread of "cocky," the name he had given to the cocks and hens when in the country. He localized this evil thing in the bathroom of the house, and he attributed pains in the stomach to the malign influence of "cocky." * Fear created the gods, according to Lucretius, and in this invention of evil beings bent on injuring him the child of a civilized community probably reproduces the process by which man's thoughts were first troubled by the apprehension of invisible and supernatural agents.

On the other hand, we find that the childish impulse to seek aid leads to a belief in a more benign sort of being. C——'s stanch belief in his fairies who could do the most wonderful things for him, and more especially his invention of the rain-god (the Rainer), are a striking illustration of the working of this impulse.

Even here, of course, while we can detect the play of a spontaneous impulse, we have to recognize the influence of instruction. C——'s tutelary deities the fairies were, no doubt, *suggested* by his fairy stories; even though, as in the myth of the Rainer, we see how his active little mind proceeded to work out the hints given him in quite original shapes. This original adaptation shows itself on a large scale where something like systematic religious instruction is supplied. An intelligent child of four or five will in the laboratory of his mind turn the ideas of God and the devil to strange account. It would be interesting, if we could only get it, to have a collection of all the hideous eerie forms by which the young imagination has endeavored to interpret the notion of the devil. His renderings of the idea of God appear to show less of picturesque diversity.†

It is to be noted at the outset that for the child's intelligence the ideas introduced by religious instruction at once graft themselves on to those of fairy lore. Mr. Spencer has somewhere ridiculed our university type of education with its juxtaposition of classical polytheism and Hebrew monotheism. One might perhaps

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* See Mind, vol. xi, p. 149.

† According to Prof. Earl Barnes, the Californian children seem to occupy themselves but little with the devil or hell. See his interesting paper, Theological Life of a Californian Child, Pedagogical Seminary, vols. ii, iii, pp. 442 *et seq.*

with still greater reason satirize the mixing up of fairy story and Bible story in the instruction of a child of five. Who can wonder that the little brain should throw together all these wondrous invisible forms, and picture God as an angry or amiable old giant, the angels as fairies, and so forth? In George Sand's child-romance of Corambé we see how far this blending of the ideas of the two domains of the invisible world can be carried.

For the rest, the child in his almost pathetic effort to catch the drift of this religious instruction proceeds in his characteristic matter-of-fact way by reducing the abstruse symbols to terms of familiar everyday experience. He has to understand, and he can only understand by assimilating these exalted conceptions to homely, terrestrial facts.

Hence, as we all know, the frank, undisguised materialism of the child's theology. God is imaged as a man preternaturally big—as a big blue man, according to one child; as a huge being with limbs spread all over the sky, according to another; as so immensely tall that he could stand with one foot on the ground and touch the clouds, to another; strong like the giant his prototype. He dwells in heaven—that is, just the other side of the blue and white floor, the sky. He is so near the clouds that, according to one small boy (our little friend the zoölogist), the clouds are a sort of pleasance, made up of hills and trees which God has made to saunter in. To other children he seems still lower down; one little girl of five being in the habit of climbing an old apple tree to visit him and tell him what she wanted. With some others, on the contrary, God's abode is put farther away in one of the stars.*

As we have seen, the childish intelligence is apt to envisage God as a citizen properly housed and leading the life of a sort of great lord in a big house or palace. He gets hungry like mortals, and has his regular meals. He has, according to some of the Boston children, birds, children, and Santa Claus living with him; curious company which clearly illustrates how religious instruction is aided by observation and by mythology. By one imaginative boy (our zoölogist) he was said prettily to receive visits from the birds, and to have the nightingales and the other birds to sing to him. The Californian children spoken of by Prof. Earl Barnes appear to beautify heaven spontaneously by making it a kind of park or pleasance with trees, flowers, and birds.

While thus relegated to the sublime regions of the sky God is supposed to be doing things, and of course doing them for us, sending down rain and so forth. What seems to impress children most, especially boys, in the traditional account of God, is his

* I am here quoting largely from the material collected by Prof. Stanley Hall.

power of making things. He is emphatically the artificer, the Demiurgos who not only has made the world, the stars, etc., but is still kept actively employed by human needs. According to the Boston children, he fabricates all sorts of things from babies to money, and the angels work for him. The boy has a great admiration for the maker, and our small zoölogist when three years and ten months old, on seeing a group of workingmen returning from their work, asked his astonished mother, "Mamma, is these gods?" "God," retorted his mother, "why?" "Because," he went on, "they make houses and churches, mamma, same as God makes moons and people and ickle dogs." Another child, watching a man repairing the telegraph wires that rested on a high pole at the top of a lofty house, asked if he was God. In this way the child is apt to think of God descending to earth in order to make things. Indeed, in their prayers children are wont to summon God as a sort of good genius to do something difficult for them. A boy of four years and a half was one day in the kitchen with his mother, and would keep taking up the knives and using them. At last his mother said, "L——, you will cut your fingers, and if you do they won't grow again." He thought for a minute and then said, with a tone of deep conviction: "But God would make them grow. He made *me*, so he could mend my fingers, and if I were to cut the ends off I should say, 'God, God, come to your work,' and he would say, 'All right.'"

While this way of recognizing God as the busy artificer is common, it is not universal. The child's deity, like the man's (as Feuerbach showed), is a projection of himself; and as there are lazy children, so there is a child's God who is a luxurious person, sitting in a lovely armchair all day, and at most putting out (from heaven) the moon and stars at night.

With this admiration of the doer there goes naturally that of skill and practical intelligence. A little boy once said to his mother he would like to go to heaven to see Jesus. Asked why, he replied: "Oh! he's a great conjurer." The child had shortly before seen some human conjuring, and used this experience in a thoroughly childish fashion by envisaging in a new light the New Testament miracle-worker.

The idea of God's omniscience seems to come naturally to children. They are in the way of looking up to older folks as possessing boundless information. C——'s belief in the all-knowingness of the preacher, and his sister's belief in the all-knowingness of the policeman, show how readily the child-mind falls in with the notion.

On the other hand I have heard of the dogma of God's infinite knowledge provoking a skeptical attitude in the child-mind. Our astute little zoölogist, when five years and seven months old, in a

talk with his mother, impiously sought to tone down the doctrine of omniscience this way: "I know a ickle more than Kitty, and you know a ickle more than me; and God knows a ickle more than you, I s'pose; then he can't know so very much after all."

Another of the divine attributes does undoubtedly shock the childish intelligence—I mean God's omnipresence. It seems indeed amazing that the so-called instructor of the child should talk to him almost in the same breath about God's inhabiting heaven and his being everywhere present. Here, I think, we see most plainly the superiority of the child's mind to the adult's, in that it does not let contradictory ideas lie peacefully side by side, but makes them face one another. To the child, as we have seen, God lives in the sky, though he is quite capable of coming down to earth when he wishes, or when he is politely asked to do so. Hence he rejects the idea of a diffused ubiquitous existence. The idea apt to be introduced early as a moral instrument, that God can always see the child, is especially resented by that small, sensitive, proud creature, to whom the ever-following eyes of the portrait on the wall seem a persecution. Miss Shinn, a careful American observer of children, has written strongly, yet not too strongly, on the repugnance of the child-mind to this idea of an ever-spying eye.* My observations fully confirm her conclusions here. Miss Shinn speaks of a little girl who, on learning that she was under this constant surveillance, declared that she "would *not* be so tagged." A little English boy of three, on being informed by his older sister that God can see and watch us, while we can not see him, thought awhile, and then in an apologetic tone remarked, "I'm very sorry, dear, I can't (b) elieve you." What the sister —aged fifteen—thought of this is not recorded.

When the idea is accepted odd ideas are excogitated for the purpose of making it intelligible. Thus one child thought of God as a very small person who could easily pass through the keyhole. The idea of God's huge framework illustrated above is probably the result of an attempt to figure the conception of omnipresence. Curious conclusions, too, are sometimes drawn from the supposition. Thus a little girl, of three years and nine months, one day said to her mother in the abrupt childish manner: "Mr. C——" (a gentleman she had known who had just died) "is in this room." Her mother, naturally a good deal startled, answered, "Oh, no!" Whereupon the child resumed: "Yes, he is. You told me he is with God, and you told me God was everywhere; so, as Mr. C—— is with God, he must be in this room." With such trenchant logic does the child's intelligence cut through the tangle of incongruous ideas which we try to pass off as methodical instruction.

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* Overland Monthly, January, 1894, p. 12.

It might easily be supposed that the child's readiness to pray to God is inconsistent with what has just been said. Yet I think there is no real inconsistency. The child's idea of prayer appears to be that of sending a message to some one at a distance. The epistolary manner noticeable in C——'s prayers seems to illustrate this. The mysterious whispering is, I suspect, supposed in some inscrutable fashion, known only to the child, to transmit itself to the divine ear.

Of the child's belief in God's goodness it is needless to say more. For these little worshipers he is emphatically the friend in need who can help them out of their difficulties in a hundred ways. Our small zoölogist thanked God for making "the sea, the holes with crabs in them, and the trees, the fields, and the flowers," and regretted that he did not follow up the making of the animals we eat by doing the cooking also. As their prayers show, he is ever ready to make nice presents, from a fine day to a toy gun, and will do them any kindness if only they ask prettily. Happy the reign of this untroubled optimism! For many children, alas! it is all too short, the color of their life making them lose faith in all kindness and think of God as cross and even as cruel.

One of the real difficulties of theology for the child's intelligence is the doctrine of God's eternity. Puzzled at first with the fact of his own beginning, he comes soon to be troubled with the idea of God's having had no beginning. C—— showed a common trend of childish thought in asking what God was like in his younger days. The question "Who made God?" seems to be one to which all inquiring young minds are led at a certain stage of child-thought. The metaphysical impulse of the child to follow back the chain of events *ad infinitum* finds the ever-existent, unchanging God very much in the way. He wants to get behind this "always was" of God's existence, just as, at an earlier stage of his development, he wanted to get behind the barrier of the blue hills. This is quaintly illustrated in the reasoning of a child observed by M. Egger. Having learned from his mother that before the world there was only God the Creator, he asked, "And before God?" The mother having replied, "Nothing," he at once interpreted her answer by saying, "No, there must have been the place (i. e., the empty space) where God is." So determined is the little mind to get back to the "before," and to find something, if only a prepared place.

Other mysteries of which the child comes to hear find their characteristic solution in the busy little brain. A friend tells me that when a child he was much puzzled by the doctrine of the Trinity. He happened to be an only child, and so he was led to put a meaning into it by assimilating it to the family group, in which the Holy Ghost became the mother.

I have sought to show that children try to bring meaning and a consistent meaning into the jumble of communications about the unseen world to which they are apt to be treated. I agree with Miss Shinn that children about three and four are not disposed to theologize, and are for the most part simply confused by the accounts of God which they receive. Many of the less bright of these small minds may remain untroubled by the incongruities that lurk in the mixture of ideas, half mythological or poetical, half theological, which are thus introduced. Such children are no worse than many adults who have a wonderful power of entertaining contradictory ideas by keeping them safely apart in separate chambers of their brain. The intelligent, thoughtful child, on the other hand, tries at least to reconcile and to combine in an intelligible whole. His mind has not, like that of so many adults, become habituated to the water-tight-compartment arrangement, in which there is no possibility of a leakage of ideas from one group into another. Hence his puzzlings, his questionings, his brave attempts to reduce the chaos to order. I think it is about time to ask whether parents are doing wisely in thus adding to the perplexing problems of early days.

SCHOOL ETHICS.

By H. C. BLACKWOOD COWELL.

THE savage instincts which men, even in the most advanced societies, still retain, are ever prompting them to pursue courses of conduct which their civilized intellects condemn—thus causing them to be at war with themselves. "Do this," suggests the nearsighted savage instinct; "Nay, this," opposes the farseeing civilized intellect; and though much ensuing conduct is in the nature of a compromise, yet the commands of instinct are oftener obeyed than those of reason. Hence the saddest and strangest of all anomalies: men who know what is good and do what is evil. When all savage instincts shall have been supplanted by social ones, will it not seem marvelous to men that their ancestors of the nineteenth century should have persisted in courses of conduct whose evil consequences were well known to them? Even to many of us, who still feel the driving force of savage instincts, it is a matter of wonder that some of the knowledge we possess should affect in so slight a degree our habitual conduct. Daily, science makes some discovery which might be expected to alter our conduct, but we go on acting in much the same way as we did before we had gained the new knowledge. Though to-morrow it should be satisfactorily shown that the

effects of use and disuse were not inheritable, how little would such knowledge immediately affect the enacting of laws, the making of marriages, the teaching of morality, the giving of alms! Between old ideas and action the connection is strong; between new ideas and action the connection is weak.

There are two truths, forming part of the inoperative knowledge of the educational world, to which I would here call attention. The first is, that the children of civilized persons possess in a marked degree the characteristics of savages; the second, that as human beings grow old they lose mental, moral, and physical plasticity. And when we consider the facts that children possess much of the nature of savages, that savage natures prompt savage acts, that the frequent performance of savage acts tends to produce savage habits, and that age tends to fix habits by producing rigidity, the difficulty and the need of forming social characters in those of plastic age become apparent. How to supplant savage instincts by social instincts—how to produce moral natures—is the problem which educators of all kinds are called upon to solve. I do not mean to imply that educators can produce moral natures in the sense of manufacturing them, but that they can assist their growth. By imparting ethical knowledge to the young we may realize moral minds, but unfortunately moral minds do not necessitate moral natures. Civilized minds may coexist with savage natures. As the value of any knowledge is in proportion to its beneficial effect on conduct, the knowledge of what constitutes good conduct is certainly of much value, and ethics deserves a more prominent place in our schools than it now occupies. But the doing of what is good does not necessarily follow the knowing of what is good. Good deeds depend much more on the possession of social natures than on the possession of minds stored with ethical knowledge.

The obligation which children are under of obeying parents lapses when they become self-supporting. The obligation to conform to certain social laws never lapses. These laws are binding on adults and children alike. The obligation which pupils are under of observing the rules of the schools which they attend also lapses when school days are over. Obedience to parents and teachers is temporary; obedience to social laws is permanent. Yet disobedience to parents and teachers as such often meets with much severer punishment than infraction of a social law! Nay, even worse than this is true; infractions of social law are countenanced where needless college rules are strictly enforced.

When on a crowded sidewalk two pedestrians accidentally jostle each other, there usually follow mutual apologies. "The right of personal integrity," which Spencer deduces as a corollary

of his "law of equal freedom," finds recognition in civilized societies—a violation of it being with us considered a criminal offense. But in the management of schools and colleges, where one expects to meet with complete recognition of the fundamental laws governing societies, there is but little recognition of that which forbids violation of person. Happily, in America, the system of "fagging" does not exist, at least not in that gross form which disgraces the schools of Great Britain and Ireland, where, contrary to their wishes and without remuneration, small boys are compelled to perform menial work for big bullies, who beat them brutally when the work is not satisfactorily accomplished, or sometimes for amusement, as I have myself witnessed—where the analogy between a "fag" and a slave is almost perfect, each doing under compulsion unremunerated labor and being liable to the lash. Happily, I repeat, "fagging" in this form finds little favor in American schools; but, unhappily, hazing does find favor. And nearly every form of "practical joke" practiced in schools and colleges necessitates a violation either of person or property. Newcomers are expected to bear with good humor at the hands of strangers assaults upon their persons and destruction of their property—to smile blandly upon young criminals.

Nor are the crimes of schoolboys which pass as practical jokes confined to crimes against schoolfellows; there are statesmen who, over the walnuts and the wine, tell tales of their "orchard-robbing days."

A significant example of school ethics is the method of settling "difficulties" spontaneously adopted by most schoolboys—namely, the method of physical encounter. He who declines to submit his case to the pugilistic test is branded a coward. The man who covers a crime is regarded as a criminal by society, but the schoolboy who discloses a crime is regarded as a criminal, if not by society at large, at least by his fellows.

Turning from schoolboys to schoolmasters, we find that, even if they do not openly countenance the conduct here condemned, they certainly do not sufficiently oppose it. Moreover, in many schools it is customary to punish the whole school, or a whole class, for offenses presumably committed by one or more of their number whenever the offender or offenders escape detection by the faculty. It is difficult to say which is the more barbarous, the boys' method of deciding questions of justice, or the masters' method of securing the punishment of undetected offenders.

One more example, of school ethics may be given. I am informed that in a few boys' schools and in many girls' schools the head masters or mistresses are authorized, or take it upon themselves, to open letters belonging to their pupils. This is done, as

I am further informed, to preserve the honor of the pupils; but to me it has always seemed like an object lesson in crime.

Both by precept and example must justice be taught in our schools, and its observance strictly enforced, before we may expect to see fair play in the game of life.

THE BAROMETRIC MEASUREMENT OF HEIGHTS.

By J. ELLARD GORE.

THERE are several methods of measuring the heights of mountains and other elevated portions of the earth's surface above the sea level. Of these may be mentioned the following: (1) by actual leveling with an engineer's spirit level and graduated staff; (2) by trigonometrical calculation based on the measurement of the angles of elevation observed at the extremities of a carefully measured base line; (3) by observing the temperature of the boiling point of water; and (4) by reading a barometer at the sea level, and again at the top of the mountain or elevation the height of which is to be determined.

The first of these methods is certainly the most accurate, but it involves a considerable amount of labor, and for very high mountains is sometimes impracticable. The second method is sufficiently accurate if carefully carried out and a nearly level plain is available for the measurement of a base line. The third method is not accurate enough to give reliable results. The fourth is the simplest and most expeditious of all. It is especially useful for finding the difference of level between two points at considerable distances apart, and would be sufficiently accurate if certain difficulties could be successfully surmounted. A consideration of this method and the difficulties to be overcome before its accuracy can be relied upon may prove of interest to the general reader.

The principle of the barometric method is as follows: The barometer measures the weight of the atmosphere. The column of mercury in an ordinary mercurial barometer is equal in weight to a column of air of the same diameter and of a height equal to that of the earth's atmosphere. The densest portion of the atmosphere is that close to the earth's surface, and its density diminishes as we ascend. At the top of a mountain, therefore, the pressure of the atmosphere will balance a shorter column of mercury, and hence the mercury descends in the tube. From the difference in height of the mercury at the level of the sea and on the top of the mountain it is possible to calculate the height we have ascended, as will be shown further on.

There are two forms of barometers—namely, the mercurial barometer and the aneroid. Of mercurial barometers there are two forms, the "cistern" and the "siphon." The cistern form is the one most generally used for scientific observations, and is the best for measuring heights. One of the most approved forms of cistern barometers—known as "Fortin's barometer"—consists of a glass tube closed at one end and filled with mercury, the lower portion of which dips into another tube of larger diameter which contains a reservoir of mercury forming the "cistern." The bottom of the cistern is formed of leather and fitted with an adjusting screw below, for the purpose of adjusting the level of the mercury in the cistern to an ivory index point above, which marks the zero of the graduated scale. By means of this adjusting screw the mercury may also be raised so as to completely fill the cistern and tube, and thus adapt the instrument for traveling.

We need not discuss here the manufacture of barometers and the filling of the tube with mercury, an operation which must be done carefully so as to exclude air from the tube. Suffice it to say that the best method is to fill the tube gradually, and boil the mercury as we proceed by means of a spirit lamp, in order to drive out all bubbles of air which may be contained in the mercury. The tube may be filled without boiling, but the resulting instrument will not be so accurate as one in which the mercury has been boiled.

To determine the difference of elevation between two places with a mercurial barometer, several points must be attended to. In the first place, the temperature of the barometer and the temperature of the air must be noted at each station. As the mercury in a barometer is affected by heat—in the same way that a thermometer is—the temperature at which the barometer is read must be observed. For this purpose a thermometer is usually attached to the barometer. The temperature should be read as accurately as possible, for an error of one degree Fahrenheit would make a difference of about three feet in the resulting altitude. The reading of the attached thermometer should be first noted, and then the height of the barometer. To do this, first bring the surface of the mercury in the cistern accurately to the index point by means of the adjusting screw. Then tap the tube gently near the top of the column in order to get rid of the adhesion between the mercury and the glass. The height of the mercury may then be read by means of the attached scale and vernier. Sometimes the amount of aqueous vapor in the atmosphere is ascertained by another instrument. The above data being known for two stations, we substitute the values found in one of the barometric formulæ, and thus obtain the height, or

difference of height, required. Before the barometer readings can be used, this must be reduced to the *same* temperature—usually 32° F.

Various formulæ have been computed by eminent mathematicians and physicists for calculating the difference of height between two points. These formulæ depend on certain assumptions which, however, can not be considered as rigidly true. The most important of these assumptions is that the atmosphere may be supposed to be in a state of statical equilibrium. But owing to the changes constantly taking place, due to differences of temperature, humidity, winds, etc., this assumption can not be considered correct. The result will therefore be only an approximation to the truth. Assuming, however, a statical equilibrium of the atmosphere, a formula can easily be deduced from known principles. For this purpose we must first ascertain the weight of a cubic inch of air and a cubic inch of mercury at a certain temperature and pressure, and in a given latitude, say 45°. Then, by Boyle and Mariotte's law, connecting the weight of a gas and the pressure, the formula can be obtained for determining the height required. There are several elaborate formulæ used for this purpose. These include terms for altitude, latitude, temperature, and humidity. A correction for altitude is theoretically necessary owing to the diminution in the force of gravity—and, therefore, a decrease in the weight of bodies—with increased distance from the center of the earth, but this correction is comparatively very small, and may, for all practical purposes, be neglected. For the same reason a correction for latitude is mathematically required, owing to the spheroidal figure of the earth; but this, too, is very small, and may be safely neglected. The correction for temperature of the *air* is, however, very important. This term is easily computed. It is obtained—for the Fahrenheit scale—by deducting 64 from the sum of the observed temperatures at the upper and lower stations, dividing the difference by 900, and adding unity to the result. A correction for humidity of the air is also necessary; but it is doubtful whether it is desirable to complicate the formula by a correction for atmospheric moisture, the laws of which are so imperfectly understood.

In all the barometric formulæ which have been proposed the first term is constant, and common to all. It is known as the "barometric coefficient," and is $5{\cdot}744\,\frac{m}{a}$, where m is the "weight of a cubic inch of mercury at the sea level in latitude 45° at 30° F. when the barometer reads 29·92 inches," and a the weight of a cubic inch of dry air under the same conditions of latitude, temperature, and pressure. Various values of this constant have

been found, depending on the values assumed for m and a. Arago and Biot found $\frac{m}{a} = 10{,}467$. This makes the "barometric coefficient" 60,122·4 feet. Raymond's value, namely 60,158·6 feet, was found by comparing the values given by the formulæ with the results of actual leveling with a spirit level. His observations were, however, few in number, and, although his coefficient is frequently used, it is probably the least accurate of all the determinations. In Laplace's formula, Raymond's constant is used. Babinet used the constant 60,334, and in Baily's formula the constant is 60,346. In Williamson's formulæ the constant is 60,384, which is the value found by Regnault, and is probably the most accurate of all. Sometimes the coefficient in the formula is given as 10,000 *fathoms*, which is roughly correct.

We will now consider the errors underlying the barometric measurement of heights, which render the method inapplicable in cases where great accuracy is required. The most important of these sources of error is probably that due to what is called the "barometric gradient," a term frequently used in meteorological reports. Taking three points at which the barometric pressure is the same, if the atmosphere was in a state of statical equilibrium these points would lie on the same level plane. But usually this plane is not level, but inclined, and the inclination of the plane is termed the "barometric gradient." For a *number* of points the surface on which they lie would not be a plane at all, but an undulating surface. These surfaces for different heights are never parallel, and frequently slope in opposite directions. Allowance can not be fully made for this disturbing cause, but the error can, to some extent, be eliminated by making a number of simultaneous observations at the two stations, and taking the mean of the results.

Another cause of error is due to variations in the temperature of the air. It is generally assumed that the mean temperature of the column of air between two stations, one vertically over the other, is the mean of the temperatures at the upper and lower stations, but this is not always the case. The error may be partially eliminated by making observations at intermediate stations, but can not be entirely overcome. High winds also cause a variation in the height of the barometer.

In addition to the errors mentioned, there are, of course, errors of observation, and instrumental errors. The former may be caused by imperfect adjustment of the zero point, and erroneous reading of the mercury on the scale. These errors are, however, usually small, and may with care be neglected. The instrumental errors are due chiefly to imperfect graduation of the scales of the barometer and attached thermometer, the impurity of the mer-

cury, and to air in the tube. These errors may be corrected by comparison with a standard instrument.

The form of barometer known as the aneroid is also frequently used for the determination of heights, a graduated scale being added for this purpose. This scale is graduated by means of one of the barometric formulæ already referred to. The aneroid barometer usually consists of a metallic box from which the air has been exhausted, and differences of atmospheric pressure are recorded by a system of levers which act on an index hand which marks the reading on a graduated scale. In some forms of aneroid the box is not completely exhausted of air, and these are called "compensated aneroids," but the name is misleading, some of these instruments being more sensitive to changes of temperature than those not compensated. The aneroid is a very handy instrument and easily used, but for the purpose of measuring heights it is much inferior to the mercurial barometer. In some instruments the altitude scale is fixed at a certain reading, say thirty or thirty-one inches, and in others it is movable, and can be adjusted to any reading required. The latter seems the most convenient plan. In either case it is clear that absolute elevations above the sea level can not be determined with this instrument with any approach to accuracy, as there is no way of making the necessary corrections for variations in pressure, temperature, etc. The aneroid barometer should, therefore, be used only for finding *differences* of elevation, and for this purpose it will give fairly good approximate results in cases where extreme accuracy is not required.

To show the degree of accuracy attainable by the barometric method, two examples may be cited. From readings of a mercurial barometer at the summit of Mont Blanc and at the Geneva Observatory made by MM. Bravais and Martins in the year 1844, the height of the mountain above the level of the sea was computed to be 4,815·9 metres, or 15,800·44 feet. Corabeuf found by trigonometrical measurement a height of 15,783 feet, or 17·44 feet less than that indicated by the barometer.

The height of Mount Washington, in the United States, was found by a spirit level to be 6,293 feet above sea level, while the barometric method gave 6,291·7 feet, a close approximation. In some other cases, however, much larger differences have been found, and the good agreements quoted above may perhaps be considered as accidental.—*Gentleman's Magazine.*

THE proper method of using a tent in Albania, according to Mr. W. H. Cozens Hardy, "is to pitch it, and then sleep under a tree three hundred yards away. The tent, and not its owner, is bullet-riddled in the morning."

BABIES AND MONKEYS.

By S. S. BUCKMAN.

IT is still a matter of scientific discussion whether man is descended from catarrhine or platyrrhine monkeys, or from the Lemuroidea; but there is little question that his ancestors were monkeylike, that they were decidedly prognathous, that they were covered with hair, that they had long tails, that they were arboreal, and that they used both the *pedes* and *manus* as hands —the former more than the latter. Man's ancestors, therefore, were very much like monkeys—they were simial or simioid, "monkeylike"; and could he see them at the present day, an unzoölogical critic would probably call them "monkeys" without much cavil.

The Latin word *simus* (Greek σιμός), whence our term "simia, monkey," means literally, "flat or snub nosed." This very feature, so striking in monkeys as to have become a name for all of them, is very remarkable in our babies. Viewed in profile, a baby's nose will appear to make a concave curve, the nostrils being obliquely truncate. The length of the nose is only equal to the breadth across the nostrils, and those are remarkably large, parted by a broad septum. During life nothing changes more than the nose. As the baby grows into a child the length of the nose increases faster than the breadth, so the snub-nosed baby grows into a more or less long-nosed and, it may be, hook-nosed adult. The snub nose remains a marked feature for a longer or shorter period of life—this is a matter of sex and parentage or race; but the change is gradual and imperceptible, generally more expeditious in the male than in the female, correlated with various other characters, such as intellectual attainments or weak constitution, and producing somewhat different results. The change, however, in the shape of the nose is one that continues throughout life. During maturity and senescence the bridge of the nose tends, as it did during childhood, to become more and more prominent: often it will become more and more convex, so that extreme old age may frequently develop an aquiline nose, even in some cases to produce the nut-cracker type of nose-meeting-chin so noticeable in old people.

It is only by a study of the face in profile, and of the face of the same individual at different ages of life, that the above changes can be properly noticed. The three-quarter photographs which we leave behind at the present day, faked up by the photographer's art, will be useless to the men of the future as records to tell what manner of people we were. With lapse of time, the widening of the family circle, and the various incidents

of a workaday life, it is doubtful if these pictures will be regarded with any reverence or affection by our posterity from a merely sentimental point of view. But this would be changed if photographs were, as should be all photographs which aim to give a true picture of the face, taken just two ways—profile and full face. They would then be of scientific value; and even a dilettante scientific amateur of the future would esteem a family collection as something of interest for the lessons in evolution or anthropology it might teach: perchance, the theme might be the "Inheritance of Acquired Characters." The want of such photographs at the present day makes it extremely difficult to impress upon the layman or to prove to the scientist how much people change facially during life. Three-quarter views give but a feeble idea of the development. Nothing is more remarkable than a comparison of the same-sized profile views of the same person at six and at thirty years of age: the growth of the nose and the development of the forehead are so great that the jaws appear to have diminished in size; and this is really what the jaws have done, in proportion to the whole face.

It is a fond delusion with visitors and nurses that *the* baby is just like its father or mother. No one who has had that scientific training necessary to proper observation could make such a statement. It is a gross libel, sometimes on the baby, sometimes on the parents. Properly taken photographs show that the proportions of nearly every feature in the face of a baby and an adult are entirely different; but the greatest difference exists in the size and shape of the nose, and the size of the jaws. If, when adult, we had features like our babies, we should have a countenance of a negroid type. Except positive evidence be available, it would hardly be credible that the small-jawed, long and prominent-nosed individual, with high forehead, was in babyhood prognathous, short and snub-nosed, with a remarkably receding forehead. The difference resulting from the change during life as shown by two photographs reduced to the same size, not the same proportion, is greater than the difference between many species; yet the very fact of such metabolism and the possibility of its earlier transmission from generation to generation may be the basis of specific mutation, without calling in the aid of natural, or sexual, or physiological selection to account for that phenomenon.

The prognathism of a child is less noticeable than it should be, because such prognathism, owing to the disposition of weight, alters the whole carriage of the head; and the difference in the method of carrying the head obscures the prognathism to a certain extent. Prognathism is a heritage from quadrupedal ancestors, and is a necessary result of the carriage of the head en-

forced by a four-footed mode of progression. The attainment of the upright body-position of man tends during the course of his life to reduce prognathism—an adult is far less prognathous than when a baby; and it has tended during phyletic development to the same end—the European, the more developed form, is less prognathous than the negro. Reduction of prognathism leads to a better carriage of the head, because the weight is borne nearer the perpendicular, which is economy. Economy, it may be remarked, is most important to the man whose expenditure and income are too nearly on a par; and this dictum of necessity applies to civilized man, whose income in the shape of physical and nervous energy is much less, and his expenditure far greater, than that of the savage. But there are other factors at work: the civilized man requires the enlargement of the frontal capacity of his skull, and material saved in jaw-making can be utilized in skull-enlargement. Then there is the lessened use of teeth and jaws in mastication, and therefore a smaller demand upon those organs: these and other causes all work to the same end—a reduction of prognathism. If any one will draw to the same size the facial profile of a cat, a monkey, a baby, and an adult man, he will have represented four stages in the reduction of prognathism, and he will begin to understand to what the prognathous baby points. He will learn that in a designed biped the heavy jaw is a piece of faulty construction reflecting no credit on an artificer, whereas it is a necessary accompaniment of a biped developed from a quadrumanous or quadrupedal animal, imperfectly, incompletely, and gradually adapting himself to the bipedal position.

Attention may be called to another feature pointing out the same lesson of alteration and imperfect adaptation. Below the nose runs a furrow parting the upper lip. In the faces of babies and children this furrow is very noticeable: from the evolutionist's point of view it is one of the most remarkable characters of the face. It tends to become obsolete in old age, and it is not seen among the catarrhine monkeys. Among the platyrrhines it is but feebly developed; but in lemurs it is in a more pronounced state—there is a depressed septum to which the two side pieces are joined—the upper lip, in fact, is nearly split in two, but held together by a depressed piece of flesh. In the Marsupialia and Rodentia the lip is practically in two pieces, and each piece is capable of being moved separately. This is the "harelip"; and its method of use may well be noticed in a hare or a rabbit when eating. The furrow, therefore, in a child's lip points to this: that our ancestors possessed, not a single upper lip, as we do now, but two upper lips, one beneath each nostril, both capable of independent movement. In course of time these two lips have, owing

to the nonrequirement of independent movement, grown together to form the single lip which we now possess; but the line of junction is not perfect, and so the furrow results; and sometimes there is a distinct scar down the middle of the furrow. The possession of this furrowed upper lip by children is one of the strongest pieces of evidence against the descent of man from any catarrhine, and in favor of his descent from platyrrhines, or from lemurs through the intervention of platyrrhinelike ancestors, of which there are no exact living representatives.

Another feature of a child's face is capable of similar explanation as a vestigial relic of its ancestors' other modes of life. The pouchlike cheeks of a baby are particularly noticeable, and they may be especially remarked in the representation of cherubs adorning ecclesiastical monuments. In such connection it savors of sacrilege to suggest that these inflated baby-cheeks, so much admired by all mothers, and regarded by churchmen as particular features of a hypothetical higher sort of beings—angels—are really the attributes of a lower order, and are the vestiges of cheek-pouches, possessed for storing away food, as in *Cercopithecus*, a monkey in which this habit of storing may be observed at the Zoölogical Gardens, if visitors feed it.

There is no need to enter into embryological or anatomical details concerning the characters for which children are indebted to monkeys. They possess in common with their adults a rudimentary tail hidden beneath the skin; but this is not a fact that every one can verify on the instant. Yet those who have the care of children can easly see for themselves the scar which the loss of the tail has still left on children's bodies—a scar which is curiously similar to what would obtain after amputation of a tail. Just at the base of the vertebral column—exactly where the tail would protrude through the flesh if it were functionally active—is a deep circular depression, sufficient almost for the insertion of the little finger. In young babies it is very noticeable; and nurses, while wondering what purpose it serves, abuse it as a place which is difficult to wash. In older children it gradually becomes shallower; and in those about five or seven years old it may or may not be shown. That it marks the place where a tail formerly protruded in our ancestors there can be no doubt from its shape and its position. I was curious to see if the anthropoid apes, which share with man this loss or rather atrophy of the tail, also exhibited this tail-mark; and I was interested to notice, in an adult female gorilla in the British Museum, that the tail-mark was as large as a florin. Its persistence to the adult stage in the case of the gorilla and its earlier loss in man is probably accounted for by the latter having attained a more perfect upright carriage of the body, and therefore a consequent in-

crease of necessary muscles have occupied the somewhat vacant space.

Other characters, however, tell the same tale of adaptation. The proportion in length between the arms and legs of a baby when first born is very different to what obtains later in life. To use a somewhat incorrect phrase, the legs are in an undeveloped condition, and they have to grow quicker, in proportion, than the arms. The greater development of the arms in proportion to the legs in a newborn infant points to ancestors who used the arms more than the legs for sustaining the weight of their bodies, and this would mean that they lived an arboreal life. Dr. Louis Robinson, in an interesting article,* has fully illustrated the reason for superior arm-power in infants by his experiments on the hanging power of babies.

In the method of using its hands the baby shows to the full its descent from arboreal ancestors. When it wishes to take hold of anything, alike a glass or a flowerpot, it does not, like an adult, put the hand round it, or even put the thumb inside to use as a lever. On the contrary, it places all the fingers inside, makes no use of the thumb, and clasps the rim of the flowerpot between the fingers and the palm of the hand. This is exactly the action which would be acquired from arboreal ancestors: in going from bough to bough they would take their hands palms first, and would strike from above downward, grasping the bough with the fingers. Such is the action of an infant picking up a cup. So little use have some monkeys made of the thumb that abortion has resulted; and in the most arboreal species of monkeys known the fingers have grown together because the whole hand was used merely as a grasping-hook. It is probably from our ancestors' excessive use of the hands in bough-grasping that our babies inherit a certain inability to move the fingers with freedom, or to extend the hand, especially if the least degree cold. The power to extend the fingers perfectly straight is oftentimes not obtained by children at six or seven years of age.

Turning to the characteristics of an infant's feet and its habits of movement therewith, much instruction may be obtained by noticing these matters. Darwin observed the infant's ability to twist the sole sideways in a straight line with the inner part of the leg, a necessary ability to a tree-climbing animal; and he cited it as evidence of monkey ancestry. Considering how little an adult can move his or her toes, the power of movement of these organs by an infant is something remarkable, and it points to some ancestral environment of very different character from that which surrounds man at the present day. The big toe the

* Nineteenth Century, November, 1891, p. 838.

infant can project at an angle from the next toe, and the space between the big toe and the next is really the remnant of a space similar to that seen between our thumb and forefinger, when the toe was used for grasping like a thumb, and was opposable. It is not, as churchmen would have us believe, a relic of sandal-wearing times, and a special provision of a deity for the patriarchs to strap on their sandals: it is a relic of monkey ancestry taken advantage of by the ancients as the most appropriate place for the sandal strap. The big toe further reveals its former thumblike use in the fact that it and the thumb are the only two of the digits in which the last joint can be bent at will and independently of moving others. This can readily be exemplified in the thumb: the baby is fond of showing its power in this direction with its big toe. Further, a baby can move any of its toes independently, and it can move them one from another so as to make a v between any of them. As it grows older it loses this power and also the power of turning its ankle; but that it has such power over its muscles when young points to ancestors who used their feet more than their hands as organs for picking up small objects, and who relied on their arms and hands for supporting their bodies. Now we have reversed this process; we require our feet merely as pedestals, and as such they would be quite as serviceable to us did we possess but one toe. In time we may come to that monodactylous condition, for abortion of the toes is proceeding very rapidly. In a great measure we owe this to boots; and the more we try to hasten, unconsciously perhaps, this process of toe-abortion, the more we shall suffer. We suffer enough as it is in this respect. Certainly the sandal-wearing ancients were not free from encouraging the toe-abortion; for the examination of any old statuary will reveal a very marked abortion of the little toe, as a consequence of the strap-pressure; and there is even a certain amount of elevation of the outside of the foot from the ground, partial atrophy. Though from a hygienic point of view sandals were preferable to boots, nothing at all, except in extreme climatic conditions, would have been preferable to sandals. Boots are a curse to civilization. Every now and then one receives missionary circulars asking for sympathy and pity on behalf of children running about without shoes and stockings, citing it as a terrible proof of poverty. After all, it is the best thing for them; many doctors are prescribing "barefootedness" in cases of limb-weakness; and it is a good thing for all young children. There has been too much fussy meddlesomeness in these respects, particularly among savage races. Thus, Mr. J. Theodore Bent says: "The missionaries who teach and insist on clothing among races accustomed to nudity by heredity are responsible for three evils: firstly, the appearance of lung diseases among them; secondly, the spread of

vermin among them; and thirdly, the disappearance from among them of inherent and natural modesty." It is a terrible indictment of the clothes-culture. When shall we be educated enough to know that clothing and decency are not synonymous terms, and that a fig leaf is a greater outrage on good taste than is absolute nudity?

It is remarkable how much unnecessary suffering is inflicted on infants and children because parents fail to recognize the ancestry from "animals,"* and consequently the instincts, different from those of adults, which children have inherited. Thus Dr. Louis Robinson has pointed out that as soon as children are able to shift for themselves in bed, they go to sleep on their stomachs with their limbs curled up under them; and he has rightly traced this to quadrupedal ancestors. Experience shows that if mothers would only recognize this ancestry, and would put their children to bed less enveloped in clothes and less tightly tucked up, so that these children might easily shift into the position which inherited instinct tells them to assume, they (the mothers) would have far more comfortable nights and better-tempered, healthier children.

Even the very manner in which babies are got off to sleep—by rocking in the arms or in a cradle—is an inheritance of arboreal or monkeylike ancestors, because the rocking is an imitation of the to-and-fro swaying of the branches, and such swaying would be the natural accompaniment of sleep with arboreal dwellers. Any rhythmic motion seems to leave a very marked impression on organisms. Thus, sailors after a long voyage complain of their inability to sleep upon land; because the sleep has been too long associated with the rocking of the vessel. More remarkable still, however, is the result of some experiments made by Mr. Francis Darwin and Miss D. Pertz † on The Curvature of Plants. They used an intermittent klinostat, arranged so as to reverse the influence of gravity on a growing shoot or stalk every half hour. When the clock was stopped they found that the rhythmic movement still continued, that the shoot or stalk actually curved in opposition to gravity for the half-hourly interval before finally obeying the impulse to grow downward. In the case of heliotrophic curvature the effect was even more marked. "After the clock was stopped the seedlings curved away from the light for *two* half-hourly intervals separated by one of curvature toward the light, so strongly were they imbued with the artificially induced rhythm." What is remarkable in these cases is

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* "Christians" and "animals" is the popular classification. See, too, Ibsen, An Enemy of the People, interruption in Dr. Stockmann's speech, "We are not animals, doctor" (Act iv).

† Journal of Botany, cit. Natural Science, vol. ii, p. 9.

the effect produced after a very short space of time. It would, therefore, be reasonable to conclude that the effect of thousands of years' association—as in the case of rocking with sleep in arboreal dwellers—would still be found to influence children very long after arboreal life had been abandoned.

It is certainly singular to find that nursery ditties contain reference to matters arboreal, as if there was some lingering tradition in the human race of ancestors who lived in trees. Thus the English mother or nurse in rocking her infant to sleep sings:

Lullaby baby on the tree top;
When the wind blows the cradle shall rock;
When the bough breaks the cradle will fall,
And down will come baby, cradle, and all.

Somewhat similar is a German nursery ditty:

Schlafe, schlaf ein, mein Kind.
Horch! da draussen der Wind;
Wie das Vöglein im grünen Baum,
Wiegt er auch dich in süssem Traum.

Nowhere is a stage of a former arboreal life, with its consequent climbing instinct, manifested more conspicuously than in the insane desire of an infant to climb upstairs. As soon as crawling is an accomplishment the climbing of stairs is attempted. Remain on the level and crawl about rooms the child will not; it must make for the nearest stairs to climb with loud crows of delight. Tumbles and consequent bruises have no effect on the child's climbing instinct, and really it regards them far less than the prohibition of its climbing feats by a too fond and foolish mother. It is better to let the child climb. Even a fall down the whole flight of stairs only checks the climbing mania temporarily, in order that the infant may loudly express its disapprobation of its own clumsiness, and may vent its anger in howls. But this episode over, it will, within a quarter of an hour, bravely attack the stairs again, having quite forgotten its late disaster. An instinct held so tenaciously can not be regarded as something fortuitous. Darwin considered that the tree-climbing propensity of boys was a relic of monkey ancestors, but he made no observation on the stair-climbing instinct of infants. Mothers, unfortunately, do not always possess enough scientific calmness to watch an infant climb stairs with every chance of a tumble, so they are apt to cut short such experiments. But if left alone—and that is the best plan—it is remarkable how soon the child learns not to tumble; and then the mother need have no more fear.

The early efforts of a child in learning to walk indicate the habits of an animal to whom the upright position is something

strange. The baby is decidedly bowlegged, but this shape of leg would be exactly that necessary for tree-climbing quadrumana. When it is first stood up, the baby puts only the outer parts of its feet to the ground, and turns its toes in. It does not allow its heels to touch the ground. When a monkey walks on a branch it does not allow the homologous part to our heel to touch the branch. When a dog sits, as we call it, to beg, it really brings the same part into contact with the ground as we do in standing. It brings its hocks (heels) flat to the ground, and supports its weight on the hocks and toes. Children are very fond of "sitting on their heels" in the same manner as a dog when it begs. The difference between the begging attitude of a dog and the standing of a child is in the straightening of the knee joints in the latter. As a dog has not the power to straighten the knee joint, because of its quadrupedal habits, it can not stand on its hocks as we can; as soon as it raises its body on its hind legs it elevates the hock from the ground. The power to straighten the knee joint, and so to put the hock to the ground, is not inherent in babies at first; it is only by practice in walking that they are able to acquire it. Why, if babies' ancestors have always been animals walking on their hocks, should these processes have to be gone through?

The movements and habits of a young baby seem so strange to us because they are so different from those made by adults, and because they are so unconsciously performed. Joy is expressed by muscular movements, by wriggling of the hands and toes, or by convulsive beatings of the arms, when it is small; by "jigging," when it is larger. These movements are expressive of joy because to any animal of highly developed muscular energy movement is absolutely essential, and particularly pleasing, while stillness is the reverse. It is muscular excitement, chiefly no doubt electrical, a heritage from ancestors who knew not what it was to be still, that gives that restlessness to children and causes them to find so much pleasure in mere motion and muscular exertion of any kind. Jumping for joy is very literally correct of a child's expression of pleasure. The prospect of a sweet will excite a series of leaps to indicate delight; and they further serve the purpose of relieving the tedium of waiting the half-second necessary to the donation. The pleasure of finding a bird's nest with eggs in it—a pleasure which must have been very real sometimes in the case of hungry monkeys and savage man, but is now only a survival of the instinct thus formed—this pleasure a boy expressed by a series of convulsive leaps into the air; and during the performance not only were the arms and legs moved as much as possible, but the muscles of the stomach and vocal organs had to be utilized to cause accompanying shouts. It may be remarked that in adults, when limb-movements are less active, shouts are,

on account of the muscular action involved, a necessary accompaniment of joy, noticeably 'Arry on a bank holiday; while in some cases expletives are symptomatic of joy and not of anger. All these outward signs have had their origin in that nerve excitation inducing muscular action which is a heritage from ancestors who, impelled by hunger, by love, or by war, led more active lives and thereby obtained a desire for motion as a second nature. Children and young lambs are very familiar examples; and so strongly will the latter pursue their gambols and racings that a broken heart is sometimes a cause of death in the middle of a sudden gallop. If children have to be still, it is torture to them—positive torture in some cases—and grown-up people are unaware how much, or they would not thoughtfully inflict it on young children. Muscular ache, the fidgets, growing-pain in the limbs, are all the result of enforced inactivity in children. It is similar with athletes: their muscular excitement is so strong that movement is pleasure, stillness means pain, and they are noted for restlessness.

Another "animal" relic which exists in children is an instinctive desire for stealing, especially for stealing fruit, which, however hard and unripe, seems to give the child pleasure. Stealing certainly points to the time when every animal had to depend on its own exertions for what food it got, and when the readiest method of obtaining such food was to appropriate without question whatever it might come across. The capacity for hard and unripe fruit indicates a necessity which would be incidental to monkeylike life—to times of scarcity, when anything in the shape of fruit, no matter what it might be, was gladly welcomed as food.

With the above another childish trait may advantageously be compared—namely, the habit of taking things to bed, especially such articles as the child may be attached to; but there is also a desire to take things for fear of other children obtaining them; and when a child takes off to bed such articles as a collection of clothes brushes, or an array of old boots, it seems like taking for taking's sake. Thus, one boy was found in bed with sundry drawer handles, unscrewed for the occasion, several pieces of old iron, two hair brushes, and a tobacco tin. Many causes have contributed to form this habit. First, there is the earlier inheritance of the maternal instinct; the mother taking her young to sleep with her, in order to feed and comfort it, would give the idea of taking to bed anything exciting fondness—dolls, toys, etc. Then there is the food instinct—the dragging-food-into-the-lair idea—with which may be associated a particular fondness of children for something to eat when they are in bed; and then there is the proprietary idea, arising from the feeling that to keep possession of

articles it is necessary to sleep with them, if not on them. When a young child is trying to resist another taking things away from it, the usual method it pursues is to put the articles between its legs, to push away its assailant with its hands, and to scream loudly. During the scream it brings its mouth into a particular shape to show its canine teeth to the best advantage, and it frequently puts its head forward, especially protruding the chin so that the other animal may have a good view of its canine teeth. This is what the reason was; with a child, of course, it is a case of inherited habit and association, because it has never known how to fight with the canine teeth.

The earlier inheritance of the maternal instinct is worth noticing further; the doll-proclivity of girls is a particular instance of earlier inheritance thereof. Doll-nursing instinct is not shared in the least by any healthy boys, nor can they take to little household duties with the handiness of a girl. Boys' earlier inheritance is all in the way of offensive weapons, of bows, bats, balls, and noise, with a tendency to teasing and bullying, a feature for which the male has been famous, the sufferer who was put upon being the female—the weaker vessel; weaker because the males fought with one another for her; had she fought with her sisters for the males she could have been the stronger and the bigger brained.

The female, however, does inherit a pugnacious instinct, chiefly defensive. She has had to fight on behalf of her young ones, and in such cases the maternal instinct becomes very strong indeed. Children show this character; and I witnessed in one of mine a very curious exhibition of what might be called perverted instinct arising from a conflict of inherited associations. She was quite a little girl and was nursing her doll with all possible expression of affection, loving it, kissing it, and calling it all the endearing names she knew. Up came her brother and began to tease her. In an instant the pugnacious idea was aroused in defense of the doll, but, having no available weapon in hand, she seized the doll by the hind legs and, wheeling it aloft, brought its china head down with resounding force on the cranium of her brother. He retired, howling and discomfited. She, excited with her triumph, returned to the caressing of her doll with redoubled ardor, quite unconscious of the incongruity of her actions, an unconsciousness which heightened the comicality of the incident.

Another habit of children—a sadly destructive habit too—is that of picking at anything loose, any piece of wall-paper especially, so as to tear it off. This habit is a survival of a monkey practice of picking off the bark from trees in order to search for insects. Any loose piece of bark, even the very least displacement, indicates an insect refuge, and immediately suggests live

prey; so that with the monkey there is a definite association between loose bark and food. With the child the reason for picking at loose things has been lost, but the instinct to pick remains as a vestigial survival, traceable to a definite food-acquiring instinct of the monkey. There may also have been an association with the monkey habit of picking out one another's parasites, a habit which is very noticeable among them.

To those people, and they are many, who scornfully repudiate their monkey ancestry, it may seem farfetched to notice such a childish habit, and to assert that it had any such origin; but many instances may be cited of habits acquired for some beneficial purpose, or in connection with some particular circumstances of life, persisting both in the life of the individual and also being perpetuated in the race long after the reason for the habit has been forgotten—not unlike superstitious ceremonies and religious observances which survive in a similar way. Thus there is the fear of women for snakes, and the consequent loathing and hatred—feelings which seem so unreasonable to many of the strong-minded people of the present day. We have written evidence that these feelings were subject of comment at a very early age of man's intelligence; and it may readily be surmised that the story of Genesis is only the written account of what had been verbally told for many generations. Mythical as it is, it seems a most ingenious method of accounting for certain observed facts; and that the facts were observed reflects considerable credit on the observers. As mythology it takes high rank; its very *naïveté* adds to its charm. "Whence arise these feelings in respect of snakes?" was the inquiry; and in answer thereto the legend gradually grew up, that "the snake was the tempter; of the presumed mother of all, Eve; he is just such as would be a tempter; his very habits, stealthy, gliding, silent, self-concealing, show at once that he 'is more subtil than any beast of the field.' Because he tempted Eve these feelings have arisen on the part of woman. The Lord God, when he found that Eve fell because of the serpent's temptation, said in his anger, 'I will put enmity between thee and the woman, and between thy seed and her seed.' That accounts for what we observe; it is all very plain." So said the sages of old. It is truly ingenious; but science gives a more simple interpretation, and yet an interpretation which, because it does not pander to the religious self-pride of human beings, in that it does not yield them that distinct rank above all other living things, is less palatable to the majority. Science says that the fear of women for snakes is an inheritance of monkeylike ancestors; that the most terrible foe of the female monkey, the foe most prone to snatch the young one from her, and even to take the mother herself on occasion, was the

deadly poisonous snakes. The terror they inspired was so great that there can be no wonder at its survival in the human female of to-day.

Another habit, a relic of what was indulged in for a definite beneficial purpose, remains to the present day—namely, the fondness of children for rolling. It points to the time when our ancestors possessed hairy bodies tenanted by colonies of parasites, and is another example of parasite irritation shaping animals' habits, alluded to above. These hairy bodies were the homes of many parasites, among which the parents of *Pulex irritans* and many another *Pulex*, together with other kinds which need not be specified, were very much in evidence; and then our ancestors, owing to less perfect articulation of joints, or to less perfection in development of the limbs, or to the thick covering of hair, were unable to reach the source of trouble effectively, and could, like horses or donkeys, only alleviate the irritation by rolling. Scratching of the head as a nervous habit, from the association between nervous irritation and actual irritation by parasites. which must also be transmitted to the brain by the nerves, is a relic of similar ancestral parasitically infested animals. It persists now among human beings who are doubtless above suspicion in the matter of unwelcome tenants; and it is a familiar expression of doubt and perplexity among οἱ πολλοί who may not be altogether so guiltless.

According to the Darwinists, the loss of hair from the body, which man has suffered in comparison with simial ancestors, is attributable to the benefit he has derived from being able to get rid of his parasites, or from the greater advantage he obtained in the struggle for existence owing to being less troubled with parasites, whose numbers diminished from want of "cover." Such an idea, however, confuses cause and effect in a most remarkable manner. The diminution of parasites is a *result* of the loss of hair, but it certainly is not the *cause* of the hair being lost. To make it so is similar to saying that the diminution of trees in newly settled countries is *caused* by a decrease in the number of wild beasts. It supposes that the greater freedom from parasites was so important to simial ancestors who lost their hair as to give them immense advantage in the struggle for existence, forgetting that this does not explain the cause of the loss of hair in the first place. With loss of hair once started, some such benefit may be granted; but what caused the loss of hair in the first place? "Spontaneous variation" is no answer at all; what is the cause of the spontaneous variation? This seems too early a stage at which to say *Ignosco* or *Ignoro*.

Then this parasite idea ought to be applied to what is going on at the present day—to the loss of hair from the head—but un-

fortunately for the parasite theory, it is among "the classes" who are certainly above suspicion so far as parasites are concerned that the loss of hair on the head is most conspicuously shown, while in the case of Hodge, who can not be regarded in the same manner, loss of hair from the head is decidedly rare. An explanation which pretends to account for what has taken place, and yet fails in application to analogous circumstances at the present day, is not one to be accepted. A true explanation of the loss of hair will explain the present-day loss as well as that of the past; the loss of hair from the head as well as that from the body; the loss of hair by the elephant as compared with the mammoth; the loss of hair on the chests of old monkeys; the loss of hair during disease in animals generally; the loss of hair during pregnancy in domestic and other animals; the loss of feathers by penned-up fowls. An explanation which is wholly physiological, and accounts for loss of hair as a pathematic symptom of individual or racial decline, assumes that such loss of hair is an exemplification of a law of reversion, that as progressive ontogenetic or phylogenetic development is, necessarily, progressive acquirement or elaboration, retrogressive development in similar cases is, accordingly, loss or degeneration of character developed during progression. This explanation, together with the assumption warranted by evidence, that the longer any character or particular feature has been transmitted in the race, the longer it will withstand adverse influences, may be applied to all the instances of hair-loss given above.

In connection with the hair it may be noticed that certain peculiarities in its mode of growth had their origin in the habits of monkeylike ancestors. On a child's head the hair grows from the crown to the forehead; but in animals which move head-first on all fours—a rabbit, for instance—it may be noticed that the hair is always directed from front to back, a character acquired by the fact of motion through air in a given direction having imparted a given lie to the hair. Such may be assumed to have been the case with the hair in the ancestors of monkeys; but when it is found, as in *Cebus vellerosus*, that the hair grows the contrary way—namely, from back to front—some cause must have induced the change. The flow of rain may be cited—the head being hung down, so that the crown is the highest part, and the rain flows off in all directions, giving the hair a lie in accordance. Now, flow of rain in the case of quadrupeds, as well as the tendency of hair to grow according to gravity, unless other causes are more potent, has made the hair on their limbs grow from the body to the extremities. In the case of man, however, and certain monkeys, the hair on the forearm grows in just the contrary direction—namely, toward the

elbow. Here, again, according to Darwin, rain has been the modifying agent; the habit of clasping the hands over the head during rain has caused the rain to flow from the hands to the elbows, and has given the hair direction in accordance, These, of course, are "acquired characters"—the lie of the hair is in accordance with certain disposing forces of environment. Such causes do not act on us now; but there are no causes acting to the contrary in a sufficiently potent manner. Consequently, we retain by the conservatism of heredity a character acquired in response to the necessities of environment in our prehuman ancestors.

To return to the persistence of habit, the case of sucking may be noticed. Sucking, of course, is the act of childhood—it is one of the most important incidents connected therewith. The baby sucks to satisfy hunger; and associated with sucking are the feelings of warmth, sleep, and comfort. But hunger means distress; and sucking to satisfy hunger means sucking to alleviate a particular distress; consequently, it has developed into sucking to alleviate any distress or pain generally. Thus, when an infant is hurt, it turns in its distress to its mother; it desires to suck, and it forgets its trouble in sucking. All these associations are potent in later life. It may be observed in many children long after they have given up sucking; when they are cross, or when they are teased, or angry, and vexed, they suck their thumbs. Many children in the same way can not go to sleep without sucking something—their thumbs generally being ready implements for the purpose—so persistent is the association of sucking with sleep. In later life children suck the ends of their pens or pencils when in doubt and perplexity over their lessons, from the association of sucking with distress or anxiety; and in still later life the masher, and the young man whose ideas do not flow very readily, suck the ends of their walking-sticks when they are in doubt or anxiety, in conversational or amatorial matters—such act of sucking being a relic of the baby habit acquired by the infant from the asssociation of sucking with alleviation of distress, no matter in what way it was caused. Further, the number of men who suck the ends of their mustaches,* and of women who suck the ends of their crochet or knitting needles, or anything else, whenever they have the least feeling of doubt, annoyance, anxiety, distress, discomfort, or the like, points to the persistence of a youthful habit long after all reason for it has ceased, and forms an instructive lesson in the development of the methods used to express emotions.

In other animals equally curious habits may be noticed, par-

* Apart from the sedative effects of nicotine, the sucking at a pipe may also be soothing from the inherited association. Some nonsmokers suck straws.

ticularly in domesticated animals, because inherent organic conservatism carries into the new state of life habits and instincts useful to the old. The turning round of a dog before it goes to sleep, and what my children call the "kneading-dough" action of a cat when before a warm fire, have been noticed before. But it may be remarked that when a cat takes a piece of meat she invariably gives it a shake—a habit acquired by the wild animal to shake off blood-drops and any adherent grit obtained by the flesh from contact with the ground, but an entirely useless performance in the case of a domestic cat fed on cooked meat in a carpeted room. Ducks which are kept away from a pond will, when it rains, or when they hear the splashing of water, repeatedly raise and lower their heads with a jerking motion—the same action which they use when in the water in order to throw the water over their bodies to wash themselves. Ducks delight in water, and consequently these washing movements are intimately associated with pleasure. Thus they feel pleasure when they are let out after confinement, though they may not be near water; and this pleasure they express by going through the washing movements—in fact, the association is so strong that these movements have become a conventional expression of pleasure of any kind. Young lambs will mount any hillock in a field, because their wild parents were dwellers in mountainous countries. We ourselves, when we wish to express scorn, or contempt, or anger, draw up our lip so as to expose the canine teeth—the weapons with which our monkey ancestors were wont to fight, as has frequently been pointed out. Babies, when they cry—and thus wish to express rage and indignation—draw the mouth into a quadrate shape. This peculiar set of the mouth in a crying infant was noted by Darwin;* but the reason for it does not seem to have been grasped. It arises, however, from the fact that crying is associated with anger, that in anger the fighting instinct is dominant, that the fighting instinct leads to a display of weapons on the *noli-me-tangere* principle, that the weapons of our ancestors were caniniform teeth in the upper and under jaws. It may be observed that the lips of a crying baby's mouth are so disposed as to exactly display the caniniform teeth as much as possible; but here comes the curious part of the whole matter—a young baby shows the quadrate-shaped mouth more remarkably than older children; yet it has no teeth to display, for the teeth are not to be seen in the gums. Here is a habit, acquired for a definite purpose, persisted in afterward when no means are available for fulfilling the purpose, and yet persisted in because of the long association in ancestors of the weapon-display with anger. For a

* Expression of the Emotions, second edition, chapter vi, pp. 155–158.

newly born baby to retract the corners of the lips in order to expose teeth which are still hidden in the gum is a ludicrously futile process; yet it shows in an extraordinary manner that a habit once acquired may remain, polarized, as it might be called, long after all reason for its acquirement and use had passed away.

From sadness to joy is a very welcome transition; and consequently a few remarks upon the method of expressing pleasure will not unsuitably follow those on the expression of pain. To show that they are pleased, human beings frequently draw up and wrinkle the nose the while they elevate the upper lip so as to expose the teeth. The same action may be noticed in terriers to express pleasure, and it is called "grinning": in children it is a remarkably common feature. It is not general among adults; but when it be a regular habit in any individual it leads to the formation of obliquely transverse furrows each side of the nose, and so gives to the face a definite and somewhat amiable expression, which may degenerate into an unfortunate peculiarity.

The origin of this expression does not seem to have been any wish to expose the teeth, but rather a desire to sniff in as much as possible. Animals derive their greatest pleasures from the satisfaction of the sexual and gastric appetites; and all odors associated with such satisfaction would become pleasing, because they would suggest pleasant ideas to the senses. It would be pleasant, then, to inhale such odors, as the odor of a good dinner is pleasant to a hungry man about to enjoy it; and he expresses his satisfaction by sniffs. The rapid repetition of a series of sniffs in succession, necessitating certain convulsive movements of the stomach, may have been the initiation of that expression of delight called "laughter," which consists in a series of quick convulsive stomachic movements coupled with certain guttural cacklings.

What might be called the genesis of our expressions, or their historical development in the phyletic series to which man belongs, opens a very wide field. Darwin has attacked it in his Expression of the Emotions; but, though he has collected a great store of most interesting facts, the theories and conclusions which he formed in connection therewith are sometimes not so satisfactory as they should be. Particularly does this apply to his principle of antithesis, which it is admitted in a note to the second edition (page 52) has not met with much acceptance. This can hardly be wondered at; because it seems so totally opposed to that gradual acquirement and development which the Darwinian doctrine supposes. Space does not allow a further consideration of this subject, more than to say that, like other animals, children's actions when at play show mimic warfare and perverted inheritance of sexual instinct. Love and war, which played such important parts among prehuman ancestors, have left their mark

upon children's actions to-day—an influence which can be easily discerned, though it may be sometimes obscured. Even such a matter as the elevation of the eyebrows during astonishment may be traced to the desire of prehuman ancestors to erect the hair, in order to make themselves as big as possible, and therefore formidable to their foes, a habit which animals constantly exhibit when they are suddenly startled. It is the *noli-me-tangere* principle, sometimes practiced with good cause, but at other times being the merest "bluff," a veritable trading under false pretenses. It is to this practice of erecting the hair that we owe the involuntary expression during extreme terror—that of the hair standing on end with fright. By disuse we have lost the voluntary power to control the muscles which perform the function of erecting the hair; but the involuntary power still remains. Such seems to be the explanation; at any rate involuntary erection of the hair during terror is a well-known fact, treated of by Darwin.

Enough has been said to show that the characters and habits of children afford every support to the evolutionist; that what is quite unintelligible and even antagonistic to any idea of special creation becomes significant and full of meaning in the light of the doctrine of gradual development; that the actions of children when rightly interpreted tell their own tale and may fitly be compared to ancient monuments of prehistoric times; lastly, that the human infant is an interesting object of scientific research, and that even a cross baby should be calmly contemplated by the philosophic mind.—*Nineteenth Century.*

ANIMAL TINCTUMUTANTS.

By Dr. JAMES WEIR, Jr.

THE chromatic function—and I use this term to designate the faculty of changing color according to surroundings—is possessed by a number of the lower animals. The chameleon is the best known of all the tinctumutants (*tinctus*, color, and *mutare*, to change), though many other animals possess this faculty in a very marked degree. In order to understand the manner in which these changes or modifications of color take place, one must know the anatomy of the skin, in which structure these phenomena have their origin. The frog is a tinctumutant, and a microscopic study of its skin will clearly demonstrate the structural and physiological changes that take place in the act of tinctumutation. The skin of a frog consists of two distinct layers. The epidermis or superficial layer is composed of pavement epithelium and cylindrical cells. The lower layer, or *cutis*, is made

up of fibrous tissue, nerves, blood-vessels, and cavities containing glands and cell elements. The glands contain coloring matter, and the changes of color in the frog's skin are due to the distribution of these pigment cells, and the power they have of shrinking or contracting under nerve irritation. The pigment varies in individuals and in different parts of the body. Brown, black, yellow, green, and red are the colors most frequently observed. The color cells are technically known as *chromatophores.* If the web of a frog's foot be placed on the stage of a microscope and examined with an achromatic lens, the chromatophores can readily be made out. Artificial irritation will immediately occasion them to contract, or, as is frequently the case, when contracted, will occasion them to dilate, and the phenomena of tinctumutation may be observed *in facto.* Under irritation the orange-colored chromatophores, when shrunk, become brown, and the contracted yellow ones, when dilated, become greenish yellow. When all the chromatophores are dilated, a dark color will predominate; when they are contracted, the skin becomes lighter in color. Besides the pigment cells just described, Heincke discovered another kind of chromatophores which were filled with iridescent crystals. They were only visible, as spots of metallic luster, when the cells were in a state of contraction. He observed these latter chromatophores in a fish belonging to *Gobius,* the classical name of which is *Gobius Ruthensparri.* I have seen this kind of color cells in the skin of the gilt catfish, which belongs to a family akin to *Gobius.* The skin of this fish retains its vitality for some time after its removal from the body of the living animal, and the chromatophores will respond to artificial stimulation for quite a while. In making my observations, however, I preferred to dissect up the skin and leave it attached to the body of the fish by a broad base. A few minims of chloroform injected hypodermatically rendered the animal anæsthetic, and I could then proceed at my leisure, without paining it and without being inconvenienced by its movements.

The causation of tinctumutation is not definitely known. Several ingenious hypotheses have been advanced, none of them, however, being completely tenable. The theory that light acts directly on the chromatophoric cells has been proved to be incorrect. Even the theory that light occasions pigmentation is no longer tenable. I have, time and again, reared tadpoles from the eggs in total darkness, yet they differed in no respect from those reared in full daylight. The chromatophores were as abundant and responded to irritation as promptly in the one as in the other. The distinguished Paul Bert declared that the young of the axolotl could not form pigment when reared in a yellow light. Prof. Semper, on the contrary, declares Bert's axolotls to be albinos,

and states that albinism is by no means infrequent in the axolotl; also that Prof. Kölliker, of Würtzburg, reared a whole family of white axolotls in a laboratory where there was an abundance of light, and that he (Semper) never succeeded in rearing an albino, though there was less light in his laboratory than in Kölliker's, and his axolotls came from the same stock. Bert made the mistake of confounding albinism with the phenomena of etiolation as observed in plants. In fact, he gives the name etiolation to the albinism noticed in his axolotls.

There is a marked difference between the functions of the chlorophyll bodies found in plants and the chromatophores found in animals. The former play one of the most prominent parts in the drama of plant life, inasmuch as they subserve a vital function, while the latter act a minor part, because they only serve as an instrument or means of protection. Light is of great importance in its influence on chlorophyll, which is a microscopic elementary body on which the vital strength of the plant depends; while it is not at all necessary to the chromatophores, cell bodies secreting pigmentary matter for the purpose of protection. Many animals live in total darkness, yet have an abundance of pigment. I myself have seen black beetles in Mammoth Cave, Kentucky, in the neighborhood of Gorin's Dome, which is a mile or so from the entrance of the cavern. Beetles rarely range over a hundred yards from their place of birth, consequently these beetles must have been reared in darkness. On this occasion I was in search of other data, so made no critical examination of these insects. I am not prepared, therefore, to give an accurate description of them. When speaking of light, I have reference to diffused daylight, which carries no heat rays. Heat is a prominent factor in the production of color; the discussion of this fact, however, does not belong to the subject under consideration. Some experiments made several years ago on newts show that the absence of light does not influence pigmentation. My animals were kept under observation from the extrusion of the eggs until the full maturity of the animals had been reached. Great care was taken to make the experiments as accurate and as conclusive as possible. Those reared in total darkness or in a red light were always dark-colored; those reared in a yellow light were almost, if not quite, as dark as those reared in the red light; while those reared in white ironstone crocks and in diffused daylight were very much lighter, being light pearl-gray in color. This apparent (for the microscope showed that it was only apparent) absence of color in the last-mentioned individuals was due to tinctumutation. Like experiments were made on frogs with the same results. In most viviparous animals the embryo is developed in almost or total darkness, yet when it is born it has bright colors. Kerbert has

found in the cutis of the embryonic chick, about the fifteenth day, certain pigment cells. These cells have entirely disappeared by the twenty-third day. It is probable that little, if any, light can reach the chick through the shell and membranes, yet pigment cells develop and disappear again.

A butterfly emerges from the cocoon arrayed in all the colors of the rainbow, yet it was developed, while in the *pupa* state, in total darkness. It is not necessary to mention further instances; we readily see that pigmentation in animals is not necessarily dependent on light. Neither is tinctumutation the result of the direct influence of light on the chromatophores. Light, however, if not the direct, is the indirect cause of this phenomenon. Lister, in 1858, showed that animals with imperfect eyesight were not good tinctumutants, notwithstanding the fact that they had the chromatic function. He showed, by his experiments on frogs, that the activity of the chromatophores depended entirely on the healthy condition of the eyes—that is, so far as the phenomenon of tinctumutation was concerned. So long as the eyes remained intact and connected with the brain by the optic nerve, the light reflected from surrounding objects exerted a powerful influence on the chromatophores. As soon as the optic nerve was severed, the chromatophores ceased to respond to the influence of light and color, no matter how bright and varied they were. The deductions drawn from these experiments are not to be controverted or denied. The chromatophores are influenced by light reflected from objects and transmitted *via* the optic nerve to the brain; from this organ the impression or irritation goes to the nerves governing the contractile fibers of these pigment-holding glands.

Pouchet followed Lister and confirmed his conclusions by experiments on fishes and crabs. He remarked that the plaice, a fish with a white under surface and a particolored back, had the chromatic function highly developed. Among a number of specimens which appeared pale on the white sandy bottom, he met "one single dark-colored fish in which, of course, the chromatophores must have been in a state of relaxation, and this specimen was as distinct from its companions as from the bottom of the aquarium. Closer investigation proved that the creature was totally blind, and thus incapable of assuming the color of the objects around it, the eyes being unable to act as a medium of communication between them and the chromatophores of the skin." Thus far Pouchet had only confirmed Lister's observations, although it is highly probable that he was unaware of Lister's experiments. But he went a step further. There are two ways in which cerebral impressions may be transmitted from the brain to the skin: one, by way of the spinal cord and the pairs of nerves arising from it and known as spinal nerves; the other, by

two nerves running close to the vertebral colmmn—the sympathetic nerves. Pouchet cut the spinal cord close to the brain, yet the chromatophores still responded to light impression, showing that they did not receive the message through the cord and spinal nerves. He then divided the sympathetic nerves, and the chromatophores at once lost their power of contraction. Thus he proved that the sympathetic nerves were the transmitters of the optical message and not the cord. This discovery of Pouchet is, psychologically, of the greatest importance, though he failed to recognize it as such. He was satisfied with its anatomical and physiological importance. When we remember that the action of the sympathetic nerve is almost if not entirely reflex in character, we can see at once the psychological importance of this discovery. This fact makes the phenomenon of tinctumutation an involuntary act on the part of the animal possessing the chromatic function, and thus keeps inviolate the fundamental laws of evolution, which, were the facts otherwise, would be broken. By a series of experiments on newts and frogs I have confirmed the conclusions of Pouchet *in toto*. I have gone still further in demonstrating the fact that the sympathetic nerves are the conductors of the optical stimulus. Atropia, to a certain extent, paralyzes the sympathetic. Injections of this drug beneath the skin of a frog render the division of the sympathetic unnecessary. The chromatophores will not respond to light impression if the animal be placed under the influence of atropine.

A large number of the lower animals possess the chromatic function. Several years ago I placed in a large cistern several specimens of the gilt catfish. This is a pond fish and is quite abundant throughout the middle States. It is of a beautiful golden yellow color on the belly and sides, shading into a lustrous greenish yellow on the back and head. Several months after these fish had been placed in the cistern it became necessary to clean it, and the fish were taken out. They were of a dirty drab color when taken out, but soon regained their vivid tints when placed in a white vessel containing clear water. They had evidently changed color in order to harmonize with the black walls and bottom of the cistern. Some katydids are marked tinctumutants. I took one from the dark foliage of an elm tree and placed her on the lighter colored foliage of a locust. She could be easily seen when first placed on the locust. In a few moments, however, she had faded to such an extent that she was scarcely noticeable. I have observed that hte *larvæ* of certain moths, beetles, and butterflies also possess the chromatic function. The chromatophores in the *larva* of *Vanessa* are quite abundant, and this grub is a remarkably successful tinctumutant. The power of changing color so as to resemble, in coloring, surrounding ob-

jects is evidently one of Nature's weapons of defense. In some animals it is developed in a wonderful manner. Wherever it is found it becomes to the animal possessing it a powerful means of defense by rendering it inconspicuous, and in some instances wholly unnoticeable.

SCHOOLROOM VENTILATION AS AN INVESTMENT.

By GEORGE HENRY KNIGHT.

THE biographer * Carlyle relates that the father of Frederick the Great scandalized the conventionalism of his day by removing all upholstery from the electoral mansion; an object-lesson in personal cleanliness no doubt so little appreciated by his contemporaries that, if the sturdy elector escaped the nickname of "crank," it was because the word had not then been invented, at least in Brandenburg. Even six generations later it may be doubted whether Friedrich Wilhelm's antipathy to germ-haunts has been realized outside a few modernly equipped infirmary wards. To the sanitarist, however, even such merely tentative application is a hopeful one, because he has learned to accept with equanimity the impossibility of any other than a gradual adoption of ideas greatly in advance of the average public sense, and to recognize the fact that even conservatism has its uses: the keel and the ballast which hold the ship to its course and, perchance, prevent a capsize—nay, sometimes even an anchor cast to windward—may be as necessary as the guiding rudder or the propelling sail. He has, therefore, no controversy with the slowness of the change-drift if mainly in the direction of better conformity with hygienic requirements; he even looks forward to a time when factories, dwellings, lecture rooms, stores, and every other kind of edifice, public and private, will be as well ventilated and be made as absolutely fire, vermin, and dust proof as the best hospital wards.

Public indifference to hygienic requirements was significantly

* "Nothing could exceed his Majesty's simplicity of habitudes; but one loves especially in him his scrupulous attention to cleanliness of person and environment. He washed like a very Mussulman five times a day; loved cleanliness in all things to a superstitious extent, which trait is pleasant in the rugged man, and, indeed, of a piece with the rest of his character. He is gradually changing all his silk and other cloth room-furniture. In his hatred of dust he will not suffer a floor-carpet, even a stuffed chair, but insists on having all of wood, where the dust may be prosecuted to destruction. Wife and womankind, and those that take after them—let such have stuffing and sofas; he, for his part, sits on mere wooden chairs—sits and also thinks and acts, after the manner of a hyperborean Spartan, which he was."—*History of Frederick the Second, called the Great, edition 1858, p. 320, by Thomas Carlyle.*

illustrated lately in a busy manufacturing settlement in the State of Massachusetts. The city of L—— had erected and equipped a costly high-school edifice with a corps of highly paid instructors, to initiate in the more advanced branches of scholarship at the public charge pupils of whom only a minority could hope to utilize these expensive accomplishments in everyday life. All seems to have been regarded with complacency until the charge for an unusually complete ventilating apparatus was encountered. One would have thought that all pupils, whether or not able to solve a problem in differential calculus or to construe a line of Virgil, would have excellent use for their own bodies; but neither this consideration nor the almost infinitesimal magnitude of this particular outlay—an outlay which, including current expenses and interest on capital, was about half a cent per occupant daily,* in comparison with the strictly scholastic expenses—sufficed to reconcile the objectors to such unheard-of extravagance! Poverty of valid arguments was compensated by strength of epithets, and such expressions as "cranky" and "visionary" were freely applied to those who had thought it improper that rooms packed with adolescent humanity and seldom, alas! quite free from victims of contagious diseases, should be unprovided with at least a sufficiency of breathing air. The incident showed that even in cultured New England there was a minority—fortunately, a minority only—not yet emancipated from the mediæval fantasy † which contemned Nature, and which regarded the soul and the body as hostile entities, both indeed corrupt, but the latter only hopelessly so, and fit only to be "mortified" and suppressed. A strange infatuation, surely, to have held its ground for nineteen centuries, in face of the lesson left by the matchless educators of Hellas in the harmonious development of every faculty and every sense! ‡

Communications received within a few months past from various boards of health and of education * have left no doubt in the mind of the writer that the incident at L—— is a typical, not an isolated one; for example, prior to March of this year there was

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* The Annual Report of the School Committee of L—— (p. 211) gives seven mills per capita daily, which the large present attendance reduces to about five mills.

† Of Asiatic origin.

‡ Considering her rude environments and ruder origin, Greece, of the sixth to the fourth centuries before Christ, still presents the most brilliant exemplification of human progress.

* With the exception of the United States Bureau of Education publication of the herein-quoted work of Prof. Morrison, the present writer has sought vainly for any Federal statistics bearing on the subject of this paper. Indeed, such would, of course, require a Government appropriation, and schoolroom ventilation does not appear to be a subject of interest in our national councils—either legislative or executive—perhaps because there is supposed to be no "political capital" in it.

not found in a single one of the public-school edifices of the great metropolitan city of New York a complete ventilating equipment, and by the 15th of that month there was but one such.*

Prof. Gilbert B. Morrison, in his book, The Ventilation and Warming of School Buildings, says that—

> The invariable verdict of all investigators of public school ventilation may be epitomized as bad, *bad*, BAD! Some are better than others—or rather some are not so bad as others—but the difference is rather in degree than in kind.†

In a letter to the writer, so late as last February, the same author says:

> I know of no building in America which is properly warmed and ventilated. . . . I fear it will be many years before the principle of proper ventilation will be put into practical application.

That the writer "speaks by the book" in his relation of the incident at L—— would be plain to any one who should care to read the printed report of the school committee of that city. The opponents of adequate ventilation might possibly have carried their point but for the weighty advocacy of the system ultimately adopted by one who is the acknowledged Nestor of the medical faculty of L——. Of Dr. P——'s pregnant address on the occasion of the dedication of the edifice, the space at our disposal permits but a few brief extracts:

> The movement of which I have spoken has not been fully understood or appreciated by the public; but the time can not be far distant when all will recognize its merits; when even those who now deride will join in the general approval, and perhaps, as a means of obtaining popular favor, coolly assert that they themselves were chiefly instrumental in securing its triumph.
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> In the fact that provision has been made for physical exercise we may see another proof that a change is taking place in our ideas concerning the proper scope of school training. Formerly such training was that of the mind alone, bodily conditions being to a large extent ignored. Now the doctrine is generally accepted that, for the purposes of education, the individual is to be regarded not as a dual personality—body and mind—but as a *unit;* complex, indeed, but still a unit; and that the aim of the educator should be to produce a complete and healthy development of all parts.

In the system now adopted—

> The amount of fresh air which can be supplied, if desired, is three thousand cubic feet, or more, per hour, for each occupant of the building. This, according to the estimate of very careful observers, is sufficient to keep the air of the rooms pure. By this device we become independent of the weather, and can

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* Based on a communication to the writer, March 15, 1894, from Dr. A. H. Doty, Chief Inspector of Contagious Diseases, New York Board of Health.

† The Ventilation and Warming of School Buildings. By Gilbert B. Morrison. Edited by the Hon. William T. Harris, A. M., LL. D., United States Commissioner of Education. P. 95.

make sure of our air supply under all the varying conditions of this changeable climate.

Under the old means of ventilation—doors windows, and suction shafts:

The ventilation heretofore has been imperfect, with a great prevalence of cold draughts, annoying and dangerous to teachers and pupils. Unreflecting people, however, will tell you that it was well enough, and all the expenditure that has been made to secure good ventilation in this schoolhouse is unnecessary —a mere waste of money. Those who make this assertion have no arguments based on facts to present for our consideration. They simply give us their opinion, generally accompanying the expression of it with a sneer, or an opprobrious epithet, like that of "crank," hurled at the advocates of free ventilation. Now, if so important a matter as this is to be settled by authority; if any man's *ipse dixit* is to be regarded as final, it should surely be that of a person who has some knowledge of the subject. I am of the opinion that the liberal supply of fresh air which has been provided for this building is necessary to the health of its occupants; and there is not a recent scientific investigator in this field, there is not a well-known writer upon hygiene, there is not an intelligent physician in the world who will not support me in this opinion. Then, what of the cost? Do you care for that, citizens of L——, if it is necessary for the health of your children? I am well assured that you do not. We, who spend our lives in effort to combat disease, can assure you that no other investment of money pays so well as that the income of which is good health; for, in securing this return, we secure with it, as a possibility at least, nearly everything which life can give of enjoyment or usefulness.*

The doctor then proceeded to give an itemized statement of the working cost of this new ventilating arrangement, and showed it to be about seven mills per occupant daily; but, inasmuch as his calculations were based on the previous attendance, and as the present year has witnessed a very notable increase of attendance, even to the extent of requiring utilization for schoolroom of portions of the library space, without increase of the total cost of ventilation, the expense may probably be safely stated as not exceeding half a cent for each occupant daily. Even this slight expenditure (not in excess but instead of that of previous expedients) may, in one sense, be regarded as no expenditure at all, in view of the fact that there is not an intelligent teacher but will testify to a manifest improvement in the result of her labors far in excess of the added cost.

The necessity of ample ventilation is therefore evident, even from the narrow merely scholastic standpoint; and we may be more sure that—as education comes to be recognized in the broader and more proper sense, which includes the full and plenary development of all the physical, mental, and moral faculties—that necessity will become more abundantly manifest.

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* Dedicatory Address at Opening of the High School of the City of L——, p. 210.

CORRELATION OF FACTORS IN ORGANIC GROWTH.

By Herr EDUARD STRASBURGER.

THE uniform co-operation of living cells in the vegetable organism appears less problematical to us when we know that these elements are connected by fine threads of living substance. These protoplasmic threads penetrate the cell walls; they immediately transmit the stimulus from cell to cell, and conduct it to a distance; and the continuity of the living substance in the whole organism is thus preserved. It formerly appeared otherwise, when the single living cell bodies were supposed to be completely separated by their walls, and these cell walls were thought to bring about the transmission. The physiological arrangements of plants have now become very much like those of animals, and nearly approach them in perfection. Very striking among the life expressions of organisms are certain processes which mutually influence and condition one another, and which we call manifestations of correlation. A particular condition in the organism invokes another, so brought about that a general balance in the functions is preserved, and is restored if disturbed.

A red-beech tree growing in the open, where it is immediately exposed to the effects of the light, has small but relatively thick leaves. Red beeches, as undergrowth in the shadow of the woods, are distinguished by considerably larger but thinner leaves. The cause of this variation lies chiefly in the difference in the conditions of transpiration. The growing leaves in the isolated tree give out more vapor to the atmosphere than do those in the shade. The increased evaporation affects the structure of the leaf surfaces, and they are compressed, chiefly because less air space is found between their cells, and partly, also, because the cells turn perpendicularly to the surface instead of increasing in breadth. All this increases the thickness of the leaf at the cost of its superficial diameter. This condition is immediately useful to the plant, because a thin and comparatively broad leaf surface would transpire too rapidly in an open situation, involving the tree in danger of drying out. In the shade, on the other hand, a large surface is necessary to give as much vapor out to the atmosphere as the life processes of the plant require; for evaporation promotes the accession of food-salts from the soil. These salts, dissolved in water, reach the plant, and are retained by it, while the water is evaporated. More rays of light fall upon a large leaf than upon a small one. In this view too, then, an enlargement of the leaf surface is more advantageous and useful in a feebly lighted situation. The intense light which falls upon a fully exposed beech may, in its greater intensity, perform as

much or even more work on the smaller leaf as the dimmer light of the shady situation on the larger one. An equivalent gain is realized by the lengthening of all the parts of the branch which takes place in the obscure situation. The leaves are thereby farther separated on the limbs, and do not cover one another. It is different in the isolated tree, where the leaves, even in a compressed situation, do not suffer for want of light. Hence, too, the great difference in the appearance of the conical crown of a solitary beech with its thickly compressed limbs and leaves, and that of the loosely spread out, umbrella-shaped undergrowth which the red beeches form in the shade of the wood.

A dry location promotes the same processes of growth as increased transpiration. The need of a plant in a dry soil is to reduce transpiration, and correlative processes are manifested through which that result is reached. The growing plant is so affected as to acquire a similar structure to that of a plant in a very sunny situation. The correlative operations in many plants take the form of giving a hairy covering to their leaves. A layer of air-retaining hairs diminishes evaporation. Hence the same plant may be hairless in moist ground, and in dry be covered with numerous hairs. The same is the case in plants from which the water supply is taken away. Superfluous growths are produced on the leaves and moderate transpiration. A slimy content is developed in the leaf cells of many plants, and serves to retain the moisture that is present within them. A dry location also generally promotes a greater thickening of the cells on the leaf surfaces, by means of which evaporation is made more difficult and prolonged. In the very cold, long-frozen soil of the arctic tundras plants have difficulty in obtaining the water they require; and in such situations, notwithstanding the real abundance of water, the same correlations in structure are found as in dry soil. The leaves are small and thick, and form slime within, and thicker cell walls on their surface. Similar rules obtain with plants in the saline soils of the steppes and the seashore Diversified conditions thus co-operate to produce the most favorable aggregate of life conditions for the plant.

The processes of transpiration in the plant appear adapted to introduce us into the difficult field of correlation, from the fact that it affords us an easier way than we can find in many other cases of looking into their mechanism. All the numerous instruments which perform the work in the organism interlock, mutually affecting and conditioning one another.

The researches of Julius Wiesner have shown that transpiration is the principal element in controlling the termination of the end bud. The vessels of our woody plants convey only a limited quantity of water to the unfolding leaves in spring. The growth

of the leaf ceases at the moment when all the water brought up is claimed by these leaves. Correlative operations then come into play. The leaf parts in process of formation then assume the shape of bud scales, and all further advance in growth is interrupted. Very simple examination will show that this conclusion of the terminal bud is not caused by any deficiency of food. If the growing shoot is brought into a room saturated with moisture, the bud is not formed. Evaporation is arrested in such a room; there is no want of water; and therefore the mechanism is not unloosed which restricts the further development of the bud. Buds already closed may also be started in a new growth in a room saturated with moisture.

The closing of the buds in the axils of the leaves is conditioned on similar causes. These buds may be easily made to expand if the branch is cut off or stripped of leaves. The advantage to the plant of this property of restoring lost leaves is seen after every instance of devastation by caterpillars. If we cut off a young potato stem just above the ground, the parts growing beneath will at once come up out of the earth. They are the threadlike shoots which would otherwise swell at the ends and form potatoes. The want of incoming nourishment acts as a stimulant to the subterranean growth, and excites processes in them by which their nature is completely changed. Instead of, as before, growing straight down into the soil, the sprout directs its end upward, soon appears above the surface, produces green leaves instead of scales, and puts on the appearance of the ordinary leafy shoot. Corresponding in principle with the behavior of this potato plant is that of trees which give their side limbs an upward direction when they have lost their leader.

The internal and external changes which a fir limb has to undergo in order to become a leader are hardly less far-reaching than the transformation of an underground potato shoot into an aërial foliage stem. We perceive that the change of the course of the water and food stuff to the highest limb, which occurs after the removal of the leader, is the correlation force by which the metamorphosis is brought about; for these causes operate as stimuli to produce a change in the relations of light and gravity, by which a doubly differentiated organ is converted into one reacting on all sides alike—in a word, the whole living mechanism is profoundly transformed. When the metamorphosis of the lateral limb into a leader is completed, it can no longer be diverted from its upright position, but returns to it with the same persistency with which it formerly resumed the horizontal position.

Not less striking are other phenomena of correlation connected with the processes of transpiration, but which can be studied only under the microscope. The moisture which plants give out to the

atmosphere escapes through special openings in the epidermis, which are called stomata, or breathing pores. These openings are not visible to the naked eye. Fifty of these stomata may be counted on a square millimetre of leaf surface, and the number sometimes rises to five hundred in the same area. Each leaf is therefore provided with several million such openings. They expand or contract according to the necessity, and the correlation is so well adapted that the width of the opening is regulated so as to agree exactly with the existing conditions. They are usually closed at night, when a strong evaporation is not called for, because the salts which the water carries into the leaf can only be elaborated in the light. The transpiration being diminished at night, besides, by the lower temperature and the increased moisture in the air, the stomata can often remain open at that time without injury. This would be the case, for example, when the breathing process—which is likewise carried on through the stomata—is prolonged. The effect of the light is to open the breathing pores at dawn if they are closed, or to expand them. An increase in transpiration is now wanted, and it facilitates the exchange of gases by the assimilation of carbon. The opening fails to respond to the stimulus of the light if there is not enough water for the demands of the plant, when rapid evaporation would promote wilting. The active mechanisms of the plant react upon the external influences, and are in turn affected by them in the manner most advantageous to the plant at the given moment. The fact that the plant is not able to choose its reactions freely causes these reactions always to occur correctly according to the course of the external conditions.—*Translated for The Popular Science Monthly from the Deutsche Rundschau.*

THE *Flora Italiana*, begun in 1848 by Filippo Parlatore, and now completed except as to a part of its seventh volume, is, according to Garden and Forest, one of the few floras of large countries or of extensive botanical regions that have come so near their end. The two others of note are Bentham's Flora of Australia and Boissier's Flora of the Orient. The other great floras, including Gray's of North America and Sir Joseph Hooker's of British India, are still unfinished. Notwithstanding the much that has been achieved in learning the characters, relationships, uses, and distribution of plants, our knowledge of them is still fragmentary and often unsatisfactory, and a vast amount of work remains yet to be done by morphological and economic botanists.

"BUCKLAND is persecuted," wrote Baron Bunsen of the eminent geologist to his wife in April, 1839, "by bigots for having asserted that among the fossils there may be a pre-Adamite species. 'How,' say they, 'is not that direct, open infidelity? Did not death come into the world by Adam's sin?' I suppose, then, that the lions known to Adam were originally destined to roar throughout eternity!"

SKETCH OF DENISON OLMSTED.

PROF. OLMSTED, the American Journal of Science said, in its obituary notice of him, "regarded his most appropriate sphere of effort, in the circumstances in which he was placed, not so much to cultivate science as to teach and diffuse it." The circumstances mentioned in this sentence called him to be a teacher, whatever lines of work he may have planned to pursue. Although his mind at different times in his life turned to other occupations and he began to prepare for them, he was as often called back to teaching by agencies outside of himself. He was a successful and superior teacher. But his achievements in independent and original research, for which he seemed to have a natural taste, were not few nor insignificant; and we can not doubt that, if he had been permitted to devote himself to that line, he might have arrived at great distinction in it.

DENISON OLMSTED was born in East Hartford, Conn., June 18, 1791, and died in New Haven May 13, 1859. His father was descended from James Olmsted, one of the first settlers of the colony of Connecticut, who died about four years after Hartford was founded. His mother was a daughter of Denison Kingsbury, of Andover, Conn., from whom he seems to have received his Christian name. His father was a farmer in moderate circumstances. He died when the son was a year old, and the care of the boy's education devolved upon his mother, who is highly spoken of as having been a lady of native strength of mind, sound judgment, and uncommon piety and benevolence. He was early trained to habits of order, diligence, and perseverance, for which he was distinguished throughout his life.

The neighborhood school was not all that was desired, and Mrs. Olmsted, in order to give her son better facilities for instruction, obtained a place for him, when he was about twelve years old, in the family of Governor Treadwell, as a chore boy, with the understanding that he should attend the district school. He was, according to the Rev. Dr. Porter, of Farmington, Conn., a very lovely, intelligent boy, and soon engaged the affections of the family. Governor Treadwell became interested in him, and took pains to help him along in his studies. Only reading, spelling, and writing were taught in the school. A proposition of Governor Treadwell to teach him arithmetic was readily accepted, and the boy made good progress under this sympathetic attention. Young Olmsted was put into a country store at Farmington, in which Governor Treadwell's son was a partner, and then at Burlington, where he had the same employer. When sixteen years old he became desirous of obtaining a liberal educa-

tion. He had already acquired a considerable knowledge of English literature, and made creditable progress in the elementary mathematics. With the consent of his guardian and his mother he went to Litchfield South Farms, to attend the school of James Morris. He undertook the care of a public district school for a short time; completed his fitting for college under the Rev. Dr. Noah Porter at Farmington, and entered Yale College in 1809. He took rank at once among the best scholars in his class, being apparently nearly equally proficient in all his studies, excelling also in writing, and cultivating a taste for belles-lettres and poetry. He was graduated with the highest honors in 1813, when he was appointed one of the orators in a class of seventy, of which only ten received that distinction. The subject of his graduation address was The Causes of Intellectual Greatness.

After graduation, Mr. Olmsted obtained a position as a teacher in the "Union School" at New London, Conn., a private institution for boys which had been supported by a few families of the place for several generations. In 1815 he was appointed a tutor in Yale College. Here he joined a small class in theology, instructed by Dr. Dwight, with the intention, which he had formed a short time before—having come under strong religious influence—of entering the ministry. Dr. Dwight died within a year, and Mr. Olmsted published a memoir of him in The Portfolio for November, 1817. The theological studies were terminated in 1817 by Mr. Olmsted's appointment to be Professor of Chemistry, Mineralogy, and Geology in the University of North Carolina.

During his tutorship at Yale in 1816, Mr. Olmsted delivered the Master's Oration on the occasion of taking his second degree, taking as his subject The State of Education in Connecticut. In this oration he brought out his plan for a normal school, which, so far as appears, was then a complete novelty, and was wholly original with him. He pointed to "the ignorance and incompetency of schoolmasters" as the primary cause of the low condition of public schools, and appealed to public and private liberality to establish and support institutions of a higher grade, where a better class of teachers might be trained for the lower schools. He has himself, in one of his letters, given an account of the origin of his conception of this scheme of "a school for schoolmasters." It was while engaged in the Union School at New London, where he had pupils of various ages pursuing a great variety of studies; so that, while the number of pupils was small, the classes were many. He discovered, he related, a marked difference in intelligence and capacity between those who were studying the languages and mathematics, preparatory to entering college, and who devoted only a small part of the day to the common rudimentary branches, such as English grammar, geography,

reading, writing, and spelling, and those who spent all their time in these elementary studies. "I was surprised to find that the former excelled the latter even in a knowledge of those very studies; they read better, spelt better, wrote better, and were better versed in grammar and geography. One inference I drew from the observation was that an extended course of studies, proceeding far beyond the simple rudiments of an English education, is not inconsistent with acquiring a good knowledge of the rudiments, but is highly favorable to it, since, on account of the superior capacity developed by the higher branches of study, the rudiments may be better learned in less time; and a second inference was that nothing was wanted in order to raise all our common schools to a far higher level, so as to embrace the elements of English literature, of the natural sciences, and of the mathematics, but competent teachers and the necessary books. I was hence led to the idea of a seminary for schoolmasters." His plan was outlined in accordance with this thought. Another encouraging feature in his scheme, as it appeared to him, was that "no sooner would the superior order of schoolmasters commence their labors, than the schools themselves would begin to furnish teachers of a higher order. The schoolmasters previously employed were for the most part such as had received all their education at the common schools, and could only perpetuate the meager system of beggarly elements which they had learned; but it was obvious that schools trained in a more extended course of studies would produce teachers of a corresponding character—that is, if we could once start the machine, it would go on by its own momentum." He was contemplating a series of newspaper articles in advocacy of his plan, and communications concerning it with eminent men interested in education, when he was called to another enterprise. The idea of normal schools was afterward taken up by other men and brought by them before the public under much more favorable circumstances than he could have commanded had he remained in Connecticut and continued his advocacy at that time.

At a later time, as a member of the Board of Commissioners of Common Schools for Connecticut, in 1840, in drafting the annual report, he observed that "wherever normal schools have been established and are adequately sustained, the experiment has uniformly resulted in supplying teachers of a superior order. As in every other art whose principles are reduced to rule and matured into a system, the learner is not limited to the slow and scanty results of his single unaided experience, but is at once invested with the accumulated treasures of all who have labored in the same before him."

Preparatory to going to the professorship of Chemistry in the

University of North Carolina, and after resigning his tutorship at New Haven, Mr. Olmsted engaged in private studies in geology with Prof. Silliman. He found at his new post two of his old friends, Yale men like himself, occupying professorial chairs: Elisha Mitchell, his former classmate, that of Mathematics and Natural Philosophy, and Ethan A. Andrews that of Languages, and here he spent seven happy years.

In 1821 he laid before the Board of Internal Improvements of North Carolina a proposition to undertake a geological survey of the State, offering to perform the entire work himself gratuitously, but suggesting an appropriation of one hundred dollars to defray his necessary expenses in traveling, to be afterward renewed or not at the pleasure of the board. The proposition was declined by the Board of Internal Improvements, but the survey was afterward made under the direction of the State Board of Agriculture. To this board Prof. Olmsted addressed his report, which was published in two parts, in 1824 and 1825, and filled in all about one hundred and forty octavo pages. The American Journal of Science observes of this survey that, regarded especially as the gratuitous vacation work of a single individual, and in view of the state of geological science in this country at the time, it "must certainly be looked upon as creditable in the highest degree both to the enterprise and to the scientific ability of its projector; and it has undoubtedly been of great benefit, not only to the State which authorized it, but to the country and to science generally, by the stimulus which it afforded to similar enterprises in other States." It was the first instance of one of the United States instituting a geological survey.

In the course of his work Prof. Olmsted gave the first geological description of the Deep River coal beds and of the new red sandstone accompanying, and referred the strata correctly to the same age with that of the Richmond coal beds and the Connecticut River sandstones.

Prof. Olmsted began researches to determine the practicability of obtaining illuminating gas from cotton seed, but removed to the North before he had secured definite results.

In 1825 Prof. Olmsted was appointed Professor of Mathematics and Natural Philosophy in Yale College. In 1836 this chair was divided at his request, and the professorship of Mathematics was assigned to A. D. H. Stanley. As a professor in Yale he performed an unbroken service of thirty-four years, till it was interrupted by his illness. His labors as a teacher during the last twenty years of his life consisted, as described by Dr. Woolsey in The New-Englander, "in teaching astronomy by a text-book, and in three courses of lectures—experimental ones on natural philosophy and optics, historical ones on the progress of astronomical discovery,

and theoretical ones on meteorology. His colleagues and friends have regarded him as a born teacher, as possessing a most happy union of several powers—the capacity to convey instruction with clearness and evidence, the capacity to impress the pupil with the importance of the branches taught, the disposition to shrink from no labor necessary in preparing himself for teaching, and to require of the student that he master and reproduce the lessons conveyed to him. While many lecturers prepare their lectures once for all, and then cease to improve them, he was constantly revising, elaborating, and almost constructing anew the courses on astronomy and meteorology which he delivered annually to the three upper classes." These lectures were spoken of by Dr. Barnard, in his Journal of Education, as having been characterized "by fullness, clearness of method, and sometimes by eloquence. The course on meteorology was, perhaps, on the whole, the most attractive and useful."

Prof. Olmsted soon became sensible of the deficiency of the text-books on which he had to rely in his department. Enfield's Philosophy was inaccurate and behind the state of science; and the work of Prof. Farrar, of Cambridge, was too extensive and too difficult. He undertook to prepare new books suitable for his classes. His Natural Philosophy appeared in 1831, and his School Philosophy in 1832. His Astronomy, first published in 1839, went through forty or fifty editions. An edition of it was printed in raised letters for the blind, it having been selected by Dr. Howe, according to Dr. Barnard, "for its clear, accurate, comprehensive presentation of the science of which it treats." The Rudiments of Natural Philosophy and Astronomy followed, in 1842. The Letters on Astronomy was a work in more familiar style, cast in the form of letters to a lady, and prepared as a reading book for the school libraries established by the Massachusetts Board of Education.

The great meteoric shower of November, 1833, which was observed over a large part of the American continent and on the ocean, directed Prof. Olmsted's mind to a new and original field of investigation; and several papers upon it were published by him and Prof. A. C. Twining, of West Point, in the American Journal of Science during 1834. The collation of the collected observations brought out the fact that the apparent point of radiation of the meteors was identical with that toward which the earth was tending in space—which indicated a cosmical origin. It was further found that several showers had been observed before within forty years, on the same day of November. In explanation of the phenomenon, Prof. Olmsted supposed, in an article published in the American Journal of Science, that the meteors "consisted of portions of the extreme parts of a nebulous

body, which revolves around the sun in an orbit inferior to that of the earth; but little inclined to the plane of the ecliptic; having its aphelion near to the earth's path; and having a periodic time of one hundred and eighty-two days, nearly." Two of the principal features of this theory—those of the cosmical origin of the meteors and their periodicity—are still maintained; but instead of one periodical shower, astronomers now count several; and instead of a single infraterrestrial nebulous body, they connect the several showers each with a particular comet. Priority in putting forth these conceptions was disputed by Chladni, whose claims, however, do not seem to have been so definitely established as those of Prof. Olmsted. Of course, the suggestion of the cosmical origin of meteors, as a suggestion, was never wholly new, for it had been made in general terms by other philosophers, from Anaxagoras down; but the credit is claimed for Prof. Olmsted of having first embodied it in a definite, coherent theory, accompanied with valid evidence; whether or how far Chladni may have anticipated him, his conclusions, as Prof. Silliman well says, were undoubtedly original with himself, and entirely independent of any results of preceding investigations. His work was, furthermore, spoken of in the most complimentary terms by the most distinguished foreign students in those lines of the day. Humboldt referred, in the first volume of his Cosmos, to the excellent description which Prof. Olmsted had given of the shower in November, 1833, and to his brilliant confirmation of Chladni's view that the phenomenon was of cosmical origin. Olbers praised him for his circumstantial description and collection of particulars of the shower, and agreed with him in the conclusion that it came from abroad. Biot, in a communication to the French Academy in 1836, spoke of his "very comprehensive and highly interesting work" in collecting and making known "all the circumstances of position, direction, and periodicity peculiar to the meteors of the 13th of November."

In his first memoir on the shooting stars, Prof. Olmsted suggested that the explanation of the cause of the meteors of November 13th might include that of the zodiacal light. He further published a well-matured thory of the nebulous body represented by the zodiacal light. Biot agreed with him in this view, and recognized his priority in the conception. Astronomy has not yet satisfied itself concerning the nature of this phenomenon. He also studied the aurora borealis, concerning which he contributed articles to the American Journal of Science in 1835 and 1837, and gave at length a theory of cosmical origin and secular period in the eighth volume of the Smithsonian Contributions to Knowledge.

He thus ascribed shooting stars, auroras, and the zodiacal

light to substantially the same origin. These views, however, as Prof. Silliman observes, were mostly thrown out only as conjectures, and not as formal theories to be held and defended.

Previous to this, Prof. Olmsted had interested himself in meteorological studies. In 1830 he published in the American Journal of Science a new theory of hailstones, in which he ascribed the origin of those formations to the sudden mingling of large bodies of hot and humid air with air extremely cold, by which the vapor of the former would be rapidly condensed and congealed into hail. These effects, he assumed, would be produced whenever, by means of opposing winds, whirlwinds, or other atmospheric disturbances, hot air should be brought above the line of congelation or cold air brought below it.

He agreed with Redfield in supposing that ocean gales are progressive whirlwinds; and he believed that he had established their laws or modes of action on an impregnable basis. This view of storms as progressive whirlwinds still holds good as a generalization; but his further ascription of the ultimate causes of atmospheric disturbances to the diurnal and orbital motions of the earth has not found an accepted place in science. Prof. Olmsted had a close friendship and a warm sympathy with Mr. Redfield, with whose views respecting the rotatory motions of storms he agreed; and he read an affectionate memorial of him before the American Association, at Montreal, in 1857.

Prof. Olmsted and Prof. Loomis, who was then a tutor in the college, were the first persons of all observers to find Halley's comet on its return in 1835. One of the results of this observation was the awakening of an interest in procuring larger and improved telescopes. It did not bring immediate fruit, it is true. The project already conceived for the establishment of a permanent observatory at Cambridge, to which it gave a new impulse, was not yet to be made real. There were other circumstances, however, than want of interest in astronomy that kept such liberal schemes from being carried out—the country and the universities had not grown up to them, and the needed abundance of money had not yet come—but this was one of the incidents that kept the movement vital and sped it on. Prof. Olmsted also conceived a plan for the establishment of an observatory at Yale College, which should have two departments: one to aid in the instruction of students and the other for the use of scientific observers; but the time had not yet come for this. As another incident of his astronomical work, President Woolsey relates that "for a number of years, until his health forbade it and his eyesight began to fail, he was accustomed to gather his class around him on a bright autumn evening and introduce them to the heavenly bodies. In this way he endeavored to train up a

corps of practical observers, whose labors, when they should be scattered abroad in this vast country, should not be lost to science."

In purely practical lines of enterprise he invented an excellent stove which bore his name, and the patent for which brought him considerable profit; and he devised a preparation of lead and rosin for lubricating machinery.

Of his qualities as a teacher Prof. Silliman mentions especially his uniform kindness and courtesy of demeanor and patience in imparting instruction; the excellent moral influence he always exerted, his consistent Christian example, his personal counsels, the genuine friendliness of his disposition, and the unaffected interest he always manifested in the welfare of his pupils. He was ever ready to encourage and assist any who exhibited special fondness for the studies of his department, and it always gave him pleasure when students passed beyond the bounds of ordinary attainment.

He labored to make knowledge more accessible to the people, and science comprehensible and interesting to them. Dr. Barnard, who describes him from the point of view of a teacher, says that he "availed himself at all times of the lyceum and the popular lecture, as well as of the daily press, to apply the principles of science to the explanation of extraordinary phenomena of meteorology and astronomy, as well as to the advancement of domestic comfort and popular improvement generally. In an essay read before the American Association for the Advancement of Education, at New York, in 1835, he showed, in a felicitous manner, that the whole tendency and drift of science, its inventions and institutions, is democratic."

Besides the works already mentioned, Prof. Olmsted published many articles of a scientific or literary character in the leading periodicals of the day—contributing thus to the American Journal of Science, The Transactions of the American Association, The Smithsonian Contributions, The Christian Spectator, and The New-Englander. He was especially fond of biographical composition, and his memoirs of Dr. Dwight, Sir Humphry Davy, Governor Treadwell, Eli Whitney, and William C. Redfield are mentioned by Prof. Silliman as favorable examples.

A YOUNG sea lion was born in the *Jardin d'Acclimatation*, Paris, on the 8th of June. It spent its first two days on the rocky platform on which it was born. The third day it imprudently slipped into the water, where it floundered about awkwardly till its mother had to come to the rescue. She took it by the skin of the neck, as a dog or a cat would do, and carried it ashore. The mother takes great care of her offspring, holding her flipper over it, as if to protect it, while it is asleep.

CORRESPONDENCE.

PROFESSOR EDWARDS AND THE UNIVERSITY OF TEXAS.

Editor Popular Science Monthly:

DEAR SIR: Referring to an editorial in your October number, entitled Another Raid on the Doctrine of Evolution, and complaining of the dismissal of Charles L. Edwards from the chair of biology in the University of Texas, I beg leave to say that you have been misinformed in regard to the facts in the case.

Prof. Edwards was not dismissed because he was not a Texan. The policy of the university has been from the beginning, and is now, to get the best men possible, regardless of State lines. Eleven years ago, when the university was organized, all the academic professors were from other States than Texas. At present we have six professors from the North, and the successor of Prof. Edwards was born in Illinois and educated in Indiana, Prof. Edwards's own State, and came to us two weeks ago from De Pauw University.

In dismissing Prof. Edwards the regents did not break their contract. He was employed for three years; but this engagement was subject to the following provision embraced in the organic law of the university: "The regents shall have power to remove any professor, tutor, or other officer connected with the institution, when, in their judgment, the interest of the university shall require it." This provision was and is known to every professor in the university, as it is published in every catalogue. It was known to Prof. Edwards, for he was one of the committee of three that edited the catalogue last year. Prof. Edwards served two years as Professor of Biology, and was then dismissed by the regents, on the ground that "in their judgment the interest of the university required it."

Prof. Edwards was not dismissed because he taught the "doctrine of evolution." He was dismissed because he was the author of an anonymous article in the Austin Evening News of June 18, 1894, libeling a member of the Board of Regents, an officer of that board, and a member of the faculty. Regular written charges were preferred against him, alleging that this publication was evidence that he was not a proper instructor for young men. Prof. Edwards was heard in his own defense, but the charges were sustained, and his summary dismissal followed as a matter of course. The alleged fact, therefore, that he was removed because he was an evolutionist is pure invention.

Yours respectfully,

THOMAS D. WOOTEN,
Pres. Board of Regents.

THOMAS D. WOOTEN, *Chairman,*
T. M. HARWOOD,
Executive Committee.

AUSTIN, *October* 1, 1894.

EDITOR'S TABLE.

THE CASE OF PROFESSOR EDWARDS.

DR. WOOTEN, President of the Board of Regents of the University of Texas, states in a letter which we publish above that Prof. Charles L. Edwards was not dismissed from the chair of biology in that university because he taught the doctrine of evolution, but "because he was the author of an anonymous article libeling a member of the Board of Regents, an officer of that board, and a member of the faculty." Dr. Wooten is, of course, entitled to make this statement if he believes it to be true; but, considering that both in local journals and in press dispatches from Austin, the seat of the university, to papers all over the country it was freely stated that the objection made to Prof. Edwards was that he taught the doctrine of evolution, Dr. Wooten might very properly have explained how that impression got abroad, and why the Board of Regents did not take an earlier opportunity to correct it. We have before us a dispatch from Austin to the Chicago Times, bearing date May 26th last, in which it is ex-

pressly stated that the Board of Regents were considering charges made in private and from the pulpit that Prof. Edwards was "teaching the Darwin theory, and not orthodox science of creation as treated in the Bible." If that statement was not true, surely the Board of Regents might, for the credit of the university, have taken the trouble to contradict it. We have before us also the letter in which Prof. Edwards was apprised of his dismissal. There is not a word in it of the now alleged ground of dismissal; simply a statement that in the opinion of the regents "the interest of the university requires your immediate removal." This letter bears date June 21, 1894. Is it not most singular, considering the light in which the matter had previously been represented in the press, that the Board of Regents should not have thought it worth while to put on record in this letter that their action was based not on any objection to the professor's evolutionary views, but on a specific act of personal misconduct, if such was really the case?

Dr. Wooten characterizes as "a pure invention" the statement that Prof. Edwards was removed because he was an evolutionist, but he does not state whether, in point of fact, the teaching of evolution is permitted in the University of Texas. If it can be declared without reserve that the successor of the late professor of biology is perfectly free to teach his class on the lines of evolution, then the statement that Prof. Edwards did not incur loss of office on account of his scientific views will at least have a measure of plausibility. Certainly, judging by the tone of the article in the Austin Daily Statesman from which we quoted in our October number, and of a further article in the same journal replying to our comments, we should judge that the life of an evolutionist professor in the Lone Star State would not be a happy one. The Statesman now says that the article we quoted from in October was only a local one dealing with rumors. We can only say that the style of that article and that of the undoubtedly editorial one now before us are so remarkably similar as to suggest a doubt whether, in the Statesman office, the differentiation of local from general editorial work has yet taken place. If it has, then we must conclude that the local editor of last summer has been promoted, and now occupies the inmost sanctum. The zeal for orthodoxy and the command of picturesque and incoherent language which his earlier article displayed could not well be surpassed; but we think they are equaled in the following extract from the later and strictly editorial article: "We confess that we are not captivated by the historical accuracy of the natural affinity orthodoxy of the monkey and baboon nuptials; and if this periodical's [The Popular Science Monthly's] facts on that subject are not more correct than its representation of the reasons for the resignation of Prof. Edwards, the Texas populace are under no obligations of logic to believe the doctrine of evolution." Texas was evidently waked up too soon, and when people are waked up too soon they are apt to be cross. A few years' more slumbering on that "log" that the Statesman told us about in its former article would about meet the case.

PROGRESSIVE THOUGHT.

In marked contrast to the tone of thought which characterizes some of the educational institutions of this country is that which finds expression in a report that has reached us of the jubilee lately held of Knox College, Toronto, Canada. Knox College, as its name indicates, is a Presbyterian institution, and, if we are rightly informed, is affiliated with the University of Toronto. Be its theological complexion what it may, however, the speeches delivered at its jubilee make it evident that, as a

teaching institution, it is prepared to do full justice to the claims of science, instead of making science bend to the requirements of a stereotyped creed. The reverend Principal Grant, of Kingston, Ontario, one of the chief speakers on the occasion in question, expressed himself as follows: "The people are beginning to care less and less for controversial divinity. . . . All colleges now profess to study the Bible scientifically, and the churches therefore must accept conclusions arrived at in accordance with canons of universal validity, or perish morally in the presence of the scientifically educated world. Science is marching on irresistibly because there is no sectarianism in science. There can be none, because reason is *one*." The Rev. Dr. Burwash, President of Victoria College (Methodist), which is also affiliated with Toronto University, spoke with equal boldness. "For my own part," he said, "I have long since ceased to lecture on polemical theology, and have adopted the historical methods of comparative theology, striving from the center of union of all our doctrines to work out into a more perfect grasp of truth than could ever be possible from within the Chinese wall of our own 'ism.' There are men who think that in religion the scientific spirit has no place, and that the dogmatic must reign supreme. . . . What is the scientific spirit? It is the simple, honest desire to get at the truth. It is the candid willingness to accept the truth wherever we find it, and no matter how it may cross our preconceived opinion. Has it come to this that our creeds are more precious than the truth, that we must shut our eyes lest the blazing light of the nineteenth century should rèveal some imperfection in the form, or even in the matter, of our historic creeds?"

Principal Grant is a Presbyterian, Dr. Burwash is a Methodist, but both are on the highroad of modern thought; that is to say, both believe in the efficacy of the scientific method for the discovery of truth, and are prepared to accept whatever conclusions a right use of reason may establish. We must congratulate the Canadian public on the support they give to such men, and the liberty they allow them to speak out the best thought that is in them. It is needless to say that the fearless attitude of mind which these two college presidents display is the only safe one for religious teachers. Young men will give them their confidence and yield to their influence, if they see that they are dealing honestly with them, and trying to open their minds to the truth, not to close them against the truth. There has been too much of the latter in times past, and indeed there is too much yet; but a better day is dawning in the educational world, and there is reason to hope that before very long the old strife between theology and science will have worn itself out. In that day science will be left free to discover truth in any and every field of investigation; while religion, inheriting all of value that theology ever possessed, will not only survive, but have its recognized and assured position, as the inextinguishable tendency of man's moral nature to worship the Source of all law, and to shelter itself in the belief in an Infinite Righteousness.

FOOD FOR THE GULLIBLE.

THIBET is a very distant and inaccessible country, and therefore we may expect very remarkable things to happen in it. It is, as we know, the classic land of occultism, the favorite habitat of *mahatmas* and the most convenient place from which to slide into the astral plane. There the enlightened ones read minds just as easily as we plodding Westerns the gigantic lettering on our dead walls, pick up knowledge of all kinds by a simple effort of volition, and not only profess a contempt for time and place but practically prove to the satisfaction of the well-disposed that, so far as they are con-

cerned, the terms have no meaning or application. A very well-disposed person, Heinrich Hensoldt, Ph. D., has given in the columns of a popular magazine, The Arena, an account of an interview with which he was favored with the Dalai Lama, the supreme object of religious veneration in that country. This august person is supposed to be a reincarnation of the original Buddha. He is chosen by the priests at the age of five or six, and dies gently of his own accord when he reaches the age of twelve. Meantime he is filled with all grace and wisdom, and the writer of the article tells how powerfully he himself was impressed with what he heard from the lips of the present Dalai, a youth of about eight. In the first place, the Dalai spoke to his interviewer, who was a German, in the most fluent and idiomatic German, and in the very dialect to which the latter was native. "How," asks the writer, "could the mysterious youth have acquired a knowledge of the German language, and moreover of a dialect which is limited to a small district of the fatherland?" If, instead of asking *us* that question, the interviewer had seized his chance and asked the Dalai himself, he might have got some information. He contented himself, however, after the manner of the faithful, with "pondering a great deal over the problem," and finally arrived at the satisfactory conclusion that it was a kind of mind-reading. The Dalai, launching out thus in German, proceeded to display "an amount of wisdom which I have never since seen equaled in the most famous Oriental or Western thinkers." The samples given us, unfortunately, hardly bear out this eulogium. The learned interviewer was "astonished beyond expression by his detailed knowledge of mineralogy, botany, microscopy, etc.," but he passed by all that to repeat a few sophistical and worn-out arguments which the Dalai worked off on him in regard to the illusoriness of time and space. The idea of time is illusory because degrees of longitude converge toward the pole, and therefore contiguous points near the pole would have the same difference of time as points widely separated at the equator! The interviewer says he "was compelled to admit the force of this logic," but he required further proof before he could accept the Dalai's dictum that "the most stable of our sciences, mathematics," is also wholly based on illusion. The mysterious youth then trotted out the old Greek sophism known to logicians as that of Achilles and the tortoise. If a man had a certain sum of money to pay, and on a certain date paid half of it, then on a later date half the remainder, and then on succeeding dates half of whatever might still be due, he might go on to all eternity paying, but would never have the debt fully discharged. "Does not this," the youth asked triumphantly and yet sadly, "prove the rottenness of the entire fabric, and that your wonderfully exact science is *Maya* or illusion?" Again the learned but well-disposed interviewer bowed in acquiescence. Of course, we might feel delicate about arguing with a reincarnated Buddha; but we feel as if the suggestion might properly have been made that the argument in question, which simply affirmed that, unless you pay a debt in full, a portion will remain unpaid, was eminently in harmony with the whole theory of mathematics, which has always required us to believe that a pint will not fill a quart pot.

"We do not reason out things," said the Dalai, "but see them." And then he proceeded to use the identical ineffectual argument used by Mr. Sinnett to which we referred a month or two ago, claiming that the adepts in occult science were substantially in possession of an extra sense, and that that was why the unenlightened world did not believe in them. The slightest reflection, however, as we pointed out,

suffices to satisfy us that any one who was really in possession of an additional sense could not fail to be believed in, seeing that he could at any moment prove his possession of that sense by exercising it, and prove it to the utter confusion of those who denied his special powers. The Dalai may have surprised his visitor by his knowledge of various sciences; but whence has come the scientific knowledge which the world to-day possesses save from the untiring labors of men possessing simply the ordinary equipment of senses and faculties? But what is the use of arguing with those who wish to be deceived? For such the worn-out sophistries of a mystery-monger will carry more weight than all the lessons of human experience, and a few oracularly delivered commonplaces assume the guise of a more than earthly wisdom. But common sense and our common senses win in the long run.

LITERARY NOTICES.

SCHOOLS AND MASTERS OF SCULPTURE. By A. G. RADCLIFFE. New York: D. Appleton & Co. Pp. 593. Price, $3.

CONSIDERING the scope of this volume, we may well believe the opening statement of its preface that the difficulties of condensation involved in its preparation have been extreme. Yet there is none of the aridity of condensation noticeable in its pages. It has been the aim of the author "to tell the story of the progress of plastic art clearly, vividly, and accurately, with entire correctness so far as possible, but without needless technicalities"—to give "not only the strict history of sculpture, but some glimpses of the fresh vistas of description lately opened up, of the strange illuminations cast by modern discovery, and of the new promise discernible in modern achievement. Successive schools of sculpture are therefore shown by the flash-light of single chapters, and the personality of the great masters is brought briefly before us." The Egyptian, Assyrian, and Asiatic types of sculpture are treated before the wonderful works of the Greeks are taken up. In no case does the author rest content with a bare enumeration and description of the works named, but adds facts concerning discoveries of ancient sculptures, and bits of mythology or notes on customs connected with them. Five chapters are devoted to Greek sculpture. Its nature and subjects are first discussed, after which the chief known examples of successive periods are described. A single chapter suffices for Roman sculpture, and the same for the early Christian and the Mediæval Cathedral groups. The works of modern times are taken up by countries. Those of Italy are described under the two divisions, the age of the Renaissance and the age of Michael Angelo and his successors. Then follow accounts of the sculptors and sculpture of France, Germany, and England, and of the nineteenth century in general, the last period being brought down to include the exhibits at the Columbian Exposition. Two closing chapters on the study of sculpture in the museums of Europe and in those of America, together with the one that precedes them, are of especial value in pointing out where the masterpieces of art are now to be found, and how we may grow familiar with them. The author's style is concise yet picturesque, and the vivid panorama that is afforded by the text is splendidly re-enforced by the illustrations. There are forty-two full-page engravings, representing all the schools described, and including works by the Americans D. C. French, W. W. Story, and Thomas Crawford.

THE PRINCIPLES OF MODERN DAIRY PRACTICE FROM A BACTERIOLOGICAL POINT OF VIEW. By GÖSTA GROTENFELT, President of Mustiola Agricultural College, Finland. Authorized American Edition by F. W. WOLL. With Illustrations. New York: John Wiley & Sons. Price, $2.

As the translator and editor states, few industries have changed more during the past twenty years than has that of the production of milk and its manufacture into butter and cheese. The shallow-setting system of cream-raising has been superseded by the deep-setting system, and the latter by hand or power separators. Better knowledge of butter manufacture and milk preservation have been acquired, together with a fuller understanding of the nature and properties of dairy products and the changes to

which they are subject. This volume is intended to substitute knowledge for speculation, and to give the dairyman data whereby he can best utilize his products.

There is a preliminary introduction on bacteria and their relation to dairying, so plainly written that all may comprehend it. With this information as a basis, the author proceeds to consider milk as it is drawn from the udder—properly sterile—and describes the sources of infection in the stable and their prevention. He calls attention to the danger of pouring abnormal milk on the stable floor or of feeding it to swine. Both in Germany and Denmark swine fed on centrifuge milk slime have been found tuberculous.

The author states that milk from tuberculous cows should not be used without being freed from its infectious qualities. This is unfortunate, for there is no certain and safe method of disinfecting such milk, and Prudden's experiments have shown that the sterilized products of tubercle bacilli will produce organic lesions that are severe and permanent. Such milk should never be used for any purpose, and the cow should be killed.

We are glad to note the author's emphasis on better lighting of cow-stables; he might have cited the fact that bright light is inimical to the best growth of micro-organisms. Hesse's experiments, here cited, that in the air of a cow-stable there were one hundred and twenty bacteria and molds while in that of an occupied schoolroom there were only eighty micro-organisms to the litre, only evidences the bad ventilation of each of those places.

In the section on cooling milk he refers to the value of ice to the dairyman, though it is in a subsequent chapter that he calls attention to the fact that the ice should not come in contact with the milk, because ice may contain pathogenic micro-organisms.

It would seem that the objection to the use of soda in cleansing milk-vessels is not well founded. In surgical and other disinfection alkaline water is of value in securing an aseptic condition, and its employment in the cleaning of these vessels seems to us particularly appropriate, though, of course, the vessel should be subsequently scalded with boiling water. A thorough steaming of these vessels is one of the best procedures that can be employed.

The annual cleaning of the stable is a hygienic necessity, and the means of disinfection herein indicated are easily applied.

The difference in the number of bacteria in one cubic centimetre of milk that has been obtained in a pasture and in a barn is striking:

LOCATION.	Immediately after milking.	Half an hour.	Two hours.
Pasture milking.....	10	88	1,530
Barn milking	106	980	3,655

Knopf has found from 60,000 to 100,000 bacteria in one cubic centimetre of recently drawn milk, and the author found in milk from a filthy stable from 670,000 to 780,000 bacteria per cubic centimetre. The investigations made by Sedgwick and Batchelder in Boston showed that milk sold in that city contained from 1,438,000 to 4,577,000 bacteria per cubic centimetre. The author gives a useful review of the various micro-organisms found in milk, and calls attention to the fact that the kinds are more important than the number of organisms.

Due importance is attached to the cleanliness of employees in butter and cheese factories, to their clothing and the cleanness of their hands.

The chapter on milk for city consumption is well written, but State dairy inspectors will have to be much further removed from political influences than they are at present before milk supplied to cities will cease to be a fertile source of causation of tuberculosis.

There is no doubt that properly condensed unsweetened milk is one of the best articles that can be used as a milk foodstuff, because it may be diluted with water as necessary, and it does not contain the pus and blood corpuscles, hair, and manure particles that are in any milk sterilized by heating. Filtration sterilization has not proved practical. A chapter is devoted to milk pasteurization, which the researches of Freeman and others have shown to be so much more satisfactory than sterilization by heating.

The advantages of the centrifugal method for cream separation and pasteurization of cream receive due consideration.

The manufacture and handling of butter

and cream are treated in the same careful manner as the preceding topics, and one can not but wish that the volume would be in the hands of every dairyman in this country.

AN ELEMENTARY MANUAL OF CHEMISTRY. By F. H. STORER, Professor of Agricultural Chemistry in Harvard University, and W. B. LINDSAY, Professor of General and Analytical Chemistry in Dickinson College. New York: American Book Company. Price, $1.20.

THE authors state in the preface that this work is the lineal descendant of the Manual of Inorganic Chemistry of Eliot and Storer, and a thorough revision of Eliot, Storer, and Nichols's Elementary Manual of Chemistry. These works have been so well and favorably known that it is scarcely necessary to commend the present volume for the comprehensive and intelligent manner in which the subject is presented.

The experimental and inductive methods are employed to acquaint the student with the main facts and principles of the science, and by such discipline the observing faculties are developed. As a rule, the experiments mentioned are of a simple character, and the directions are so explicit that a novice in chemistry may repeat them before a class. The work is an excellent one for the purposes intended.

ESKIMO LIFE. By FRIDTJOF NANSEN. London and New York: Longmans, Green & Co. Pp. 350. Price, $4.

IT is for the most part with genial humor, but now and then in sadness and indignation, that Dr. Nansen describes the life of these hardy children of the North. His knowledge of them was gained mostly in one winter, during which, he says, "I dwelt in their huts, took part in their hunting, and tried, as well as I could, to live their life and learn their language." Their daily life is presented with much fullness of detail; their appearance and dress, their houses for winter and tents for summer, their cookery and what they regard as delicacies, their woman-boats, excursions, etc., receiving due attention. A chapter is given to a careful description, with measurements, of that wonderful boat, the *kaiak*, and the weapons and implements that constitute its outfit, which is followed by a vivid story of a day's hunting in these boats. Some less familiar sides of Eskimo life are presented in the chapter on art, music, and poetry, and in that on the drum dances, which served both as judicial proceedings and as entertainments. Nearly a hundred pages are devoted to religious ideas, in which some curious bits of mythology and folklore are presented. Dr. Nansen represents the character of the Eskimo as gentle and patient. It is seldom that an Eskimo does anything that his own race deems wrong, crimes of violence being especially rare. Some things, however, that he does, deeming them proper, come into our category of immoralities. In his closing chapters on The Introduction of Christianity, Europeans and Natives, What have we achieved? and his Conclusion, Dr. Nansen laments the enervating influence of the civilization that Europeans have inflicted upon the Eskimos. The introduction of firearms has led them to exterminate or scare away their game. The imposition of religious commands and civil laws in a mass too great to be assimilated has driven out the old restraints and obligations and caused the victims of the process to fall between two stools. The ability to read and write has been gained at the expense of diminished skill in the *kaiak*, so that deaths from drowning have largely increased. A long catalogue of this sort could be gleaned from Nansen's pages, and he does not hesitate to urge that his countrymen should entirely withdraw from Greenland. The text is well illustrated with plates and small cuts.

THE PENOKEE IRON-BEARING SERIES OF MICHIGAN AND WISCONSIN. By ROLAND DUER IRVING and CHARLES RICHARD VAN HISE. (Monographs of the United States Geological Survey.) Washington: Government Printing Office. Pp. 534, with Plates.

THIS report was designed by Prof. Irving to be the first of a series which should treat each of the important iron-producing districts adjacent to Lake Superior. For a time, in 1885 and 1886, Prof. Irving accompanied the surveying party in person. Mr. Van Hise gave the seasons of 1884, 1885, and the larger part of the following year to the work. When the survey began, the district was one which explorers had but fairly

entered, and which was reached by railroad at only one point. The district has since developed into one of the most important iron-producing areas of the country. Before the beginning of the investigation, Prof. Irving had done a large amount of field work upon a portion of the range for the Wisconsin Geological Survey and had prepared a systematic report upon this part of it. He was thus able to direct the more detailed examination of the whole area, so that no loss of time should occur. This is the first of the iron-producing districts of Lake Superior in which the geology has been worked out in detail, and the fundamental conclusions reached are in opposition to those expressed by some geologists. Hence, in order to make the facts fully accessible to those who desire to have them, the descriptions of the formations and their sections are given with especial particularity. The first chapter of the present report was prepared by Prof. Irving; the third, fourth, and fifth chapters were jointly prepared; and the rest is the work of Mr. Van Hise.

THIRTEENTH ANNUAL REPORT OF THE UNITED STATES GEOLOGICAL SURVEY, 1891–'92. By J. W. POWELL, Director. In Three Parts. Part I, Report of the Director. Washington: Government Printing Office. Pp. 240.

THE work of the Geological Survey is the examination of the topography and the preparation of topographical maps showing the distribution and characteristics of the rock formations of the country with their various mineral contents. Usefulness in various other ways than for the geologist is justly claimed for the maps that result from the surveys—such as the location of roads, railways, and canals, for planning towns and extensive manufactories, for drainage and irrigation systems, and for all other works depending on the configuration of the ground. These uses are multiplying, as the resources and industries of the country are developed and increase, with every decade. The geological survey of each district requiring, by reason of the diversity of rocks and resources in the different parts of the country, special knowledge of that district, the work is organized in divisions, each assigned to a particular district or series of formations, in each of which are subdivisions in which work is carried on by independent parties; and there are other divisions of special kinds of work. The topographical surveys of Connecticut, Massachusetts, New Jersey, and Rhode Island are completed. The surveys of this branch during the year covered by the report serve to complete eighty-eight atlas sheets, of which thirty-six are on a scale of 1 : 62,500 (or about one mile to the inch), forty-five are twice as large, and seven are drawn to special scales. The general maps, it is claimed, are among the first to represent with approximate accuracy the relief of any considerable part of the country. A summary of the more important features of the surveys and the administrative reports of the chiefs of divisions, showing in general terms the amount of work done in each, are given in connection with the director's report.

In Part II, Geology (pp. 372, with numerous illustrations and maps, largely swelling the thickness of the volume), are given the full and detailed reports of the second expedition to Mount St. Elias, by I. C. Russell; The Mechanics of Appalachian Structure, by Bailey Willis; The Average Elevation of the United States, by Henry Gannett; The Rensselaer Grit Plateau of New York, by T. N. Dale; The American Tertiary Aphidæ, by S. H. Scudder.

Part III (486 pages, with illustrations and maps) relates to irrigation, and contains papers on Water Supply for Irrigation, by F. H. Newell; American Irrigation Engineering, by H. M. Wilson; Engineering Results of Irrigation Survey, by Mr. Wilson; a report upon the construction of topographic maps and the selection and survey of reservoir sites in the hydrographic basin of the Arkansas River, Colorado, by A. H. Thompson; and a report upon the location and survey of reservoir sites during the fiscal year ending June 30, 1892, by John Thompson.

CLINICAL MANUAL FOR THE STUDY OF DISEASES OF THE THROAT. By JAMES WALKER DOWNIE, M. B. New York: Macmillan & Co. 1894. Pp. xiv + 268. Price, $2.50.

WHEN one recalls the six or eight hundred octavo pages of most of the popular text-books on diseases of the throat, it seems that the author of this manual has

undertaken a difficult task to dispose of his topic in such small compass.

The first of the two sections into which the book is divided discusses the systematic examination of the fauces, pharynx, and larynx, and describes the various manifestations of disease of these regions. The second section considers individual diseases and their necessary medical and surgical treatment.

It seems to us that the author would have enhanced the value of his work by referring, if even briefly, to the necessity of examining the nose, especially the posterior nares, which is the starting point for so many of the diseases described in the volume.

The section on diphtheria is too meager. Insufficient directions are given for staining the Klebs-Loeffler bacillus; nothing is said of the importance of determining the latter's presence as an early indication of the character of the disease, nor is the distinction between the true and pseudo bacillus defined. Nothing is said of the antitoxine treatment of diphtheria.

What the author does describe is clearly explained, but it seems that in his effort to write a concise work he has somewhat abridged the complete consideration of his subject.

THE DISEASES OF THE WILL. By TH. RIBOT. Authorized translation by MERWIN-MARIE SNELL. Chicago: The Open Court Publishing Company. 1894. Pp. vi+134. Price, 75 cents.

THE well-known psychological works of this author are sufficient guarantees of the treatment a subject will receive at his hands. In this volume he studies the will from the standpoint of dissolution—that is, he reviews the anomalies of the will, and from these deduces conclusions regarding its normal state.

He classes volitional impairments as defects of impulse, excess of impulse, impairments of voluntary attention, volitional instability, and extinction of will. From his survey of these pathological conditions he concludes that there are two distinct elements in every voluntary act: that state of consciousness, the "I will," that indicates a situation but that has in itself no efficacy, and a very complex psycho-physiological mechanism in which resides the power to act or to restrain. Therefore volition is defined as a final state of consciousness that results from the more or less complex co-ordination of a group of conscious, subconscious, or unconscious states that, united together, express themselves by an action or an inhibition.

He formulates this theory in the words, "The 'I will' testifies to a condition, but does not produce it." He aptly compares it to a jury's verdict that may be the result of a very long criminal examination and of fervid argument, and that will be followed by grave consequences extending over a long future, but that is an effect without being a cause.

The author sedulously avoids any discussion of the problem of free will, but a careful reading of the volume will greatly enlighten the student's mind regarding the scope of that metaphysical entity.

The volume is a readable one, and a most useful contribution to popular scientific literature.

EDUCATIONAL AND INDUSTRIAL SYSTEM OF DRAWING. By LANGDON S. THOMPSON. Boston: D. C. Heath & Co. Seven series, thirty-two books, including drawing books and manuals.

THE author deduces from a general analysis of the subject that drawing is related to every other department of intellectual education, but has no departmental existence of its own, and should not be treated as an independent subject. In every school or system of schools, therefore, the actual practice in drawing or other art work that is required should depend on the regular course of study. The seven series of which the present system consists are the manual-training, primary and advanced free-hand, model and object, æsthetic, mechanical, and institute series. The order in which these several series should be used is not laid down, but is left to be determined by circumstances. The two books of the manual-training series are not drawing books proper, but are intended to develop the analytical phase of form study. They also treat of form expression in three dimensions. The more advanced manual, No. 2, treats of elementary mechanical drawing, clay modeling in relief, lessons on color, wood-carving, cutting and pasting in design, and working drawings, and is

adapted to go with the advanced free-hand series. The four books of the latter series are intended to interest and instruct the mind of the learner, and improve his taste by giving information on the principles of pottery design and the conventionalization of plant forms for purposes of decorative design. The diagrams to be drawn are mostly historical examples of approved form. The model and object series is likewise a free-hand series, but has no drawings to be copied; the cuts and explanation being designed to illustrate the underlying principles of model drawing and the method of procedure, and to send both teacher and pupil directly to the object itself. The manual presents a clear and concise statement of the principles of model and object drawing, and can be used independently of the drawing books. The æsthetic series gives the principal elements of the best known styles of ornament, and explains them in such a way as to enable the learner to recognize those various styles at sight. The drawings are intended not to be copied, but to be studied and to point out the method to be pursued in inventing designs. The mechanical series is wholly instrumental. The institute series, with its primary grade book and grammar grade book, is made especially for teachers' institutes, normal classes, summer schools, and intelligent classes having only a limited time for study. A great elasticity is allowed in the use of these books, in numbers used, length of course, and purpose.

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION. Showing the Operations, Expenditures, and Condition of the Institution to July, 1893. Washington: Government Printing Office. Pp. 763.

THE secretary calls attention to the desirability of securing an appropriation to meet actual outlays incurred in administering Government trusts. These outlays, for matters not equitably chargeable to the fund of James Smithson, are increasing; they are incurred in serving purely governmental interests, and are not met by any of the present appropriations. In the line of research the secretary, Prof. S. P. Langley, has investigated in aërodynamics and astrophysics; aid has been given in Prof. E. W. Mosley's determinations of the density of oxygen and hydrogen; Prof. A. A. Michelson has been assisted in his study of the application of interference methods to spectroscopic measurements; Prof. Holden is engaged in lunar photography; and other investigations are reported upon. Mention is made of Mr. W. W. Rockhill's adventures in Tibet and other explorations described in the Report of the Bureau of Ethnology. Volume XXVIII of the Contributions to Knowledge consists of the memoir of Captain Charles E. Bendire on the Life Histories of North American Birds. Prof. Michelson's memoir on interference methods was also published. The thirty-fourth and thirty-sixth volumes of the miscellaneous collections contain respectively two articles previously published separately, and Dr. H. C. Bolton's new Bibliography of Chemistry. A gift of two hundred thousand dollars has been made to the institution by T. G. Hodgkins, of Setauket, Long Island, for the encouragement of the study of the nature and properties of atmospheric air in connection with the welfare of man. Mr. Hodgkins also made the institution his residuary legatee. The appendix to the report contains a large number of articles on current science, mostly selected.

HUMAN PHYSIOLOGY. By JOHN THORNTON, M. A. With 268 Illustrations, some colored. New York: Longmans, Green & Co. 1894. Pp. 436. Price, $1.50.

THE scope of this work indicates that it has been prepared for the use of high schools and colleges.

Commencing with histology, excellent ideas of a cell, of karyokinesis, of the properties of protoplasm, and of the various forms of tissue are given. Physiology proper is then taken up and considered in its various phases. The chapters on the blood and circulation are excellent, and that on the brain is especially good in its treatment of our modern knowledge of that nervous center.

The book has been prepared with great care and judgment, and is deserving of wide popularity in the field for which it is intended.

The Amateur Telescopist's Handbook (Longmans, Green & Co., New York) has been prepared by *Frank M. Gibson* for that

large number of students of astronomy whose instrumental equipment is not adequate to the satisfactory observation of a considerable proportion of the objects described in Smyth's and Webb's catalogues of celestial objects suited to observations with common telescopes. Those who have equatorially mounted telescopes of more than three or four inches aperture may find these works all they need; but those who have only alt-azimuths of smaller apertures will be liable to embarrassment from the difficulty of locating the objects described in these works, and by the presence in their lists of many that can not be seen at all with those instruments. For the purposes of this work objects are selected which are within the powers of such instruments, and the attempt has been made to describe their location so that they may be easily found without the aid of a map or lantern light. Price, $1.25.

Hermon C. Bumpus has had in mind, in the preparation of his *Laboratory Course in Invertebrate Zoölogy* (Henry Holt & Co., New York, $1), the requirements of a class of students who are pursuing a course of laboratory work on the subject. An effort has been made to direct the work without actually telling the student all that is to be learned from the specimen. An instructor is supposed to be present to assist with the hard points, and to demonstrate what can not well be elucidated by written descriptions. Not always the most typical animals are selected, but forms easily procured and preserved have been looked for. The orders of Protozoa, Cœlenterata, Echinodermata, Vermes, Mollusca, Crustacea, Limulus, Arachnoidea, and Antennata are represented by from two to seven genera each.

The work of Dr. *Hermann Adler* on *Alternating Generations*, based on *A Biological Study of Oak Galls and Gall Flies*, is published by Macmillan & Co., translated with the permission of the author, and edited by *Charles R. Stratton*. The translator became acquainted with the work while studying galls as a branch of comparative pathology, and was struck with its originality and the light it threw upon certain great biological problems. Dr. Adler began his observations of gall flies in 1875, and in the course of his investigation was able to unfold their life history, and to prove that, while many species are linked together in alternate agamous and sexual generations, others are wholly agamous. Since the existence of alternating generations was discovered by Chamisso, fresh instances of like phenomena have accumulated in which the life-cycle of the species may be represented by two or more generations, differing in form and organization, existing under different conditions, and reproducing themselves in different ways. While the galls and their generations are described by Dr. Adler, the translator suggests in the introduction a number of inquiries respecting the philosophy of the phenomenon, and especially concerning the nature and operation of the excitation by which the peculiar fruitlike forms are produced upon the trees as the result of the gall fly's work. Colored illustrations are given of forty-two species of oak galls. Price, $3.25.

Canadian Independence, Annexation, and British Imperial Federation (Putnams, 75 cents) is the amplification of an essay first written for Canadian readers by a Canadian, *James Douglas*, long resident in the United States. The imminence of political change in Canada, independence as an essential factor of imperial federation, annexation as an alternative to independence, Canada's slow progress, the probable effect of annexation on Canadian industries and wages, annexation from the point of view of comparative politics, and annexation from American and Canadian points of view are considered. The author believes that all the advantages expected from annexation can be obtained by reasonable trade arrangements.

An elementary text-book, with the title *Geometry for Grammar Schools*, has been prepared by *E. Hunt*, LL. D. (Heath). Large use of drawing is made in it, and paper cutting and folding are somewhat employed. The problems are an extension of those on mensuration usually found in text-books of arithmetic. Two copies of a protractor are printed in such a manner that the pupils may cut them out and use them in drawing.

Prof. *Dolbear's* book, *Matter, Ether, and Motion*, the first edition of which was noticed in this magazine in 1892, has reached a second edition (Lee & Shepard, $2). Three chapters have been added, dealing respectively with Properties of Matter as Modes of Motion, Implications of Physical Phenomena,

and Relations of Physical and Psychical Phenomena. In the first of these he shows how each property of matter could be regarded as a manifestation of energy; in the second he points out the bearing of certain principles of physics upon the probability of various claims of the spiritists and theosophists, while in the third he argues that whatever wonderful things really take place at *séances* are done in conformity with the laws of matter, not in opposition to them.

In the mathematical series for graded schools, by *John H. Walsh*, Part II, or *Intermediate Arithmetic*, comprises Chapters VI to X. The subjects taken up are fractions, decimals, denominate numbers, bills, measurements, and, in the last chapter, algebraic equations. Part III, or *Higher Arithmetic*, completing the series, comprises Chapters XI to XVI, dealing with the various subjects involving percentage computations, with proportion, square root, mensuration, and the metric system. There is also a chapter on algebraic equations and one on elementary constructive geometry. As special features of the series, the author calls attention to its division into half-yearly chapters, instead of by topics, the small number of rules and definitions, the great number and variety of examples, and the use of the equation. (Heath, Part II, 40 cents; Part III, 75 cents.)

The *Complete Graded Arithmetic*, prepared by *George E. Atwood*, begins with a Part I, in which the usual elementary work with integers and the manipulation of fractions are taught. It provides work for two years of three terms each. The author has aimed to incorporate enough review work in each lesson so that the teacher shall not need to do any planning of reviews. The rules and definitions are put at the end of the book and referred to by number. Part II provides exercises for three years, passing from elementary decimals through denominate numbers, the various commercial calculations involving percentage, and ending with mensuration. The making of bills, receipts, notes, drafts, etc., is a feature of the examples. (Heath, Part I, 45 cents; Part II, 85 cents.)

Any one who wishes to know what *Modern Theosophy* is will find an attempt to tell him in a book with the above title, by *Claude Falls Wright* (New England Theosophical Corporation, 24 Mount Vernon Street, Boston, $1). To the strict adherent of modern scientific thought the book will be meaningless, for it is full of assertions unsupported by anything that he is accustomed to regard as evidence—conflicting, in fact, with many things that are so supported. Perhaps not entirely meaningless, for it may serve as an instructive example of the vagaries that the human mind is capable of when not forced to occupy itself with something useful or reasonable.

An *Introduction to the Mathematical Theory of the Stress and Strain of Elastic Solids* has been prepared by *Benjamin Williamson*, a Fellow of Trinity College, Dublin (Longmans, $1.50). The book is small, but its author hopes that "it is sufficient to enable the student to understand the mathematical theory of the internal strains and stresses that arise whenever external forces are applied to solid bodies." The rapid increase in the size of the structures that modern engineers are undertaking makes a thorough understanding of the distribution of stress extremely important.

In *The Science of Vital Force*, by *W. R. Dunham*, M. D. (Damrell), the idea that the author talks about and around seems to be that medicine has no active property, but that disease is cured by vital activity.

Captain *Willard Glazier* has published another book in support of his claim to have discovered the real source of the Mississippi River (Rand, McNally & Co.). It is entitled *Headwaters of the Mississippi*, and describes the adventures of explorers of that river from De Vaca, in 1528, down to the present time. Captain Glazier's expedition which resulted in his discovery of Lake Glazier was made in 1881, and, as the importance of this lake became a matter of controversy, he made a second expedition in 1891, to obtain more convincing proof of his assertions. The story of his second expedition forms the latter part of this volume, and is followed by an appendix of letters and other documents in support of Captain Glazier's position. The volume contains a great deal of descriptive matter concerning persons and places in Minnesota, and is fully illustrated.

The little book on *Gas-lighting and Gas-fitting*, by *William Paul Gerhard* (Van Nostrand, 50 cents), contains specifications and

rules for gas piping, hints on the choice of fixtures, burners, globes and globe-holders, on the management of gas, and on the reduction of high gas bills. It also tells how to read a gas meter, how to search for a leak, and how not to search for it, and gives the advantages of cooking and heating by gas, certain historical facts, etc. Its treatment of these and other topics included in its scope is full, clear, and free from technicalities, and, while it is doubtless valuable to all who have to do with gas and gas appliances, it is especially needed by the user of gas, who has little chance to pick up the knowledge it contains in any other way.

A progressive course of *Mechanical Drawing*, arranged by *Walter K. Palmer*, has been issued (Charles B. Palmer, Columbus, O., 80 cents). It comprises projection drawing, isometric and oblique drawing, and the making of working drawings. The successive principles are stated briefly, and the student is expected to verify them with the aid of explanations and illustrations by the teacher. No drawings are shown and as few figures as possible are used, as it is expected that the teacher will supply what is needed to clear up individual difficulties. What shall be drawn under the head of working drawings is left altogether with the teacher. A liberal number of review questions is provided.

A series of newspaper letters under the title *Joint-metallism*, by *Anson Phelps Stokes*, has been published in the Questions of the Day series (Putnam, 75 cents). Mr. Stokes describes "joint-metallism" as "a plan by which gold and silver together, at ratios always based on their relative market values, may be made the metallic basis of a sound, honest, self-regulating, and permanent currency, without frequent recoinage and without danger of one metal driving out the other." In brief, his plan consists in the use of a new silver coin equal in weight to a five-dollar gold piece, which may be named "a standard." The Secretary of the Treasury shall determine at the beginning of each month what whole number of "standards" comes nearest to the value of a five-dollar gold piece, and any payment of ten dollars or over may be made half in gold and half in "standards," at the current ratio fixed by him. This mode of payment shall not apply to debts contracted earlier than six months after the passage of the act authorizing the use of the new coin.

What may be described briefly as a popular account of modern biblical criticism is presented by *Joseph Henry Crooker* under the title *The New Bible and its New Uses* (Ellis). Mr. Crooker shows very clearly how the present Bible has been constructed—by combining two or more versions of the same events, by writing down oral traditions, by mingling history with legend, by writing in prophecies after the event, and by adding various tributes of reverent fancy. He points out numerous errors and contradictions in the Bible, and shows how the Old Testament is misquoted in the New. Having thus demonstrated that the Bible is not the message of an omniscient Deity, he proceeds to show that it does not itself claim to be such. The statements of Jesus concerning the Old Testament writings were those of a man with the limited knowledge of his time. Mr. Crooker does not here raise any doubt that Jesus really said the things that he is reported to have said. Regarding the Scriptures in this light gives us in effect a "new Bible," and the author devotes a closing chapter to a discussion of the proper use of the renovated book. He says that it will be a great gain for humanity to have the surviving misuses of the Bible stopped, as many others have been already. This book must no longer be held superior to reason. But it will not therefore die. To quote from his closing paragraph: "When the bondage of a literal, a textual, and a dogmatic use of Scripture ceases, then we shall rejoice in a use of the Bible that allows reason and sentiment free scope. It is a joy to read the Bible as we would any other book, feeling that no dogmatist is near to club us if we doubt, and no roaring hell yawning for us if we reject a text here and there." The author makes numerous references to modern authorities for support and amplification of his statements.

The *Manual of Topographic Methods*, published by *Henry Gannett*, Chief Topographer, as Volume XXII of the Bulletin of the United States Geological Survey, is intended to present a description of the topographical work, instruments, and methods used by the Geological Survey, primarily for

the information of the men engaged in the work. It is not designed to be an elementary treatise upon surveying, as it presupposes a knowledge of the application of mathematics to surveying equivalent to that to be obtained in our professional schools; and it is not intended to be a treatise on topographical work, although it may to a certain extent supply the existing need of such work.

PUBLICATIONS RECEIVED.

Academy of Natural Sciences of Philadelphia. Journal. Second series. Vol. X. Part II. Certain Sand-Mounds of the St. John's River, Florida. By Clarence B. Moore. Philadelphia. Pp. 112, with Plates.

Adams, Henry C. Relation of the State to Industrial Action. American Economic Association. Pp. 85. 75 cents.

Agricultural Experiment Station of Cornell University. Sixth Annual Report, 1893. Albany. Pp. 365.

American Forestry Association. Proceedings at the Tenth, Eleventh, and Twelfth Annual Meetings, etc. Washington. Pp. 44.

Arrowsmith, Robert, and Whicher, G. M. First Latin Readings. American Book Company. Pp. 304. $1.25.

Austen, Prof. Peter T. English Examinations. Pp. 4.—Chemistry at the Polytechnic. Pp. 2.—How shall Young Men be educated in Applied Chemistry? Pp. 8.—How to Purify Drinking-Water. Pp. 4.—A Danger Signal. Pp. 3.—Oldfield Village Sermons. Part III. Pp. 9.

Bailey, L. H. Impressions of the Peach Industry in Western New York. Pp. 24.—Peach Yellows. Pp. 16.

Bardeen, C. W., Publisher, Syracuse, N. Y. Questions and Answers in American History, Civil Government, and School Law. Pp. 80.—The Teacher's Mentor. Pp. 121.—Handbook for School Trustees. Pp. 93. 50 cents.

Barlow, W. H. The Celestial Writing, or the Normal Script Phonetic Writing. Philadelphia: The Stenographer. Pp. 14.

Barnett, Mrs. S. A. The Making of the Body. New York: Longmans, Green & Co. Pp. 208.

Bay, J. Christian, Des Moines, Iowa. On the Study of Yeasts. Pp. 23.—On Compass Plants and Twisting of Leaves. P. 1.—Crystals of Ice on Plants. Pp. 6.—Sachsia (in German). Pp. 8.—A New Infection-needle for Entomological Studies (in German). Pp. 3.

Boston Society of Natural History. Proceedings, November, 1893, to May, 1894. Boston. Pp. 140.

Burt, Edward A. A North American Anthurus: its Structure and Development. Pp. 16, with Plates.

Cannon, G. L., Jr. The Geology of Denver and Vicinity. Pp. 36.

Carus, Paul. The Gospel of Buddha, according to Old Records. Chicago: Open Court Publishing Company. Pp. 275. $1.50.

Cheiro, the Palmist. Cheiro's Language of the Hand. 432 Fifth Avenue, New York. Pp. 193, with 33 Plates. $2.

Commelin, A. O. Of Such is the Kingdom, and Other Poems. New York: Fowler & Wells Co. Pp. 110. $1.50.

Corea, the Hermit Nation. American Book Company. Pp. 16.

Curry, J. L. M. Education of the Negroes since 1860. Baltimore: Trustees of the John F. Slater Fund. Pp. 32.

Davidson, Thomas. The Education of the Greek People and its Influence on Civilization. New York: D. Appleton & Co. Pp. 229.

Davis, Charles H. S., Editor. The Egyptian Book of the Dead. New York: G. P. Putnam's Sons. Pp. 186, with Ninety-nine Plates of Original Texts. $5.

Dawson, G. M. The Progress and Trend of Scientific Investigation in Canada. Pp. 17.

Dickson, W. K. L., and Antonia. The Life and Inventions of Thomas A. Edison. New York: T. Y. Crowell & Co. Pp. 332. $4.50.

Dooner, P. W. The Genesis of Water. Pp. 47.

Fernow, B. E. Report of the Chief of the Division of Forestry for 1893. Washington. Pp. 64.

Fewkes, J. Walter. The Kinship of the Tusayan Indians. Pp. 16.

Flammarion, Camille, and Gore, J. Ellard. Popular Astronomy. New York: D. Appleton & Co. Pp. 686. $4.50.

Free Lance, A. Towards Utopia. Brief Speculations in Social Evolution. New York: D. Appleton & Co. Pp. 252. $1.

Froment, A. Les Merveilles de la Flore Primitive (Wonders of the Primitive Flora). Geneva and Paris. Pp. 145.

Harrington, Mark W. Report of the Chief of the Weather Bureau for 1893. Washington. Pp. 132.

Harvard College Observatory. Observations of the New England Weather Service in the Year 1892. Pp. 32.—Observations made at the Blue Hill Meteorological Observatory, Massachusetts, in 1893, under the Direction of A. L. Roth. Pp. 69, with Plates.—Journal of Zone Observations, by M. A. Ropes. Pp. 272.

Hodgins, J. George, Editor. Work that has been accomplished during Five Years by the Toronto Humane Society, etc. Toronto, Ont. Pp. 112.

Huxley, T. H. Evolution and Ethics and Other Essays. New York: D. Appleton & Co. Pp. 334. $1.25.

Imperial University of Japan. Calendar for 1893-'94. Pp. 265, with Maps.—Journal of the College of Science. Pp. 273, with Plates.

Kennedy, John. Must Greek Go? Syracuse, N. Y.: C. W. Bardeen. Pp. 66. 50 cents.

Locy, W. A. The Mid-brain and the Accessory Optic Vesicles. Pp. 3.

Marshall, A. Milnes. Lectures on the Darwinian Theory. New York: Macmillan & Co. Pp. 236. $2.25.

May, Fanny. Saint and Sinner. New York: J. S. Ogilvie Company. Pp. 216. 50 cents.

Merriam, L. S. Higher Education in Tennessee. United States Bureau of Education. Pp. 287.

Moore, Clarence B. As to Copper from the Mounds of the St. John's River, Florida. Pp. 28, with Plates.

Newth, G. S. A Text-Book of Inorganic Chemistry. New York: Longmans, Green & Co. Pp. 667.

North Dakota Weather and Crop Service Bulletin for September, 1894. Pp. 15.

Ostwald, Wilhelm. Manual of Physico-Chemical Measurements. New York: Macmillan & Co. Pp. 255. $2.25.

Paterson, Arthur. The Daughter of the Nez Percés. New York: G. Gottsberger Peck. Pp. 381. $1.

Rayleigh, Lord. The Theory of Sound. Vol. I. New York: Macmillan & Co. Pp. 480. $4.

Robinson's New Intellectual Arithmetic. American Book Company. Pp. 192. 35 cents.

Sabin, S. B., and Lowry, C. D. Elementary Lessons in Algebra. American Book Company. Pp. 128. 50 cents.

Schorlemmer, Carl. The Rise and Development of Organic Chemistry. New York: Macmillan & Co. Pp. 280. $1.00.

Shufeldt, Dr. R. W. Lectures on Biology. Pp. 102.—On the Osteology of Certain Cranes, Rails, etc. Pp. 14.—Notes on the Steganopodes, and on Fossil Birds' Eggs. Pp. 3.

Shufeldt, R. W., and Miss Audubon. The Last Portrait of Audubon, together with a Letter to his Son. Pp. 5, with Plate

Smith, H. Q. Notes on Eskimo Traditions. Pp. 8.

South Dakota. Report of the State Board of Health for 1892. Pierre. Pp. 57.

Spencer, Herbert. A Rejoinder to Prof. Weismann. New York: D. Appleton & Co. Pp. 27.—Weismannism Once More. London. Pp. 24.

Steiner, B. C. The History of Education in Connecticut. United States Bureau of Education. Pp. 300.

Strike, Report on the Chicago. Washington: Government Printing Office. Pp. 53.

Strike, The, at Pullman. Statements of President G. T. Pullman and Vice-President T. H. Wicks before the United States Strike Commission. Pp. 38.

United States Geological Survey. Geologic Atlas of the United States. Pike's Peak Folio. Pp. 6, and 5 Maps.—Chattanooga Folio, Tennessee. Pp. 4, and 5 Maps.

Walker, General F. A. General Hancock. New York: D. Appleton & Co. Pp 332.

Wallihan, Mr. and Mrs. A. G. Hoofs, Claws, and Antlers of the Rocky Mountains with a Camera. Photographic Reproductions of Wild Game from Life. With an Introduction by the Hon. Theodore Roosevelt. Denver, Col.: Frank S. Thayer.

Ward, L. F. Recent Discoveries of Cycadean Trunks in the Potomac Formation of Maryland. Pp. 9.

Warren, L. Z. Defective Speech and Deafness. New York: G. S. Werner, 108 East Sixteenth Street. Pp. 116.

White, G. R. An Elementary Chemistry. Boston: Ginn & Co. Pp. 272.

Wood, Henry. The Only Practical and Possible Bimetallism. Boston: Lee & Shepard. Pp. 19.

Wright, Carroll D., Commissioner. Ninth Annual Report of the Commissioner of Labor, 1893. Washington. Pp. 719.

Zinet, Alexander. An Elementary Treatise on Theoretical Mechanics. Part III, Kinetics. New York: Macmillan & Co. Pp. 237. $2.25.

POPULAR MISCELLANY.

Decrease of Russian Rivers.—A diminution in the quantity of water in the rivers of eastern Europe, particularly in Russia, has been recognized for a long time. Koeppen began to seek for the cause of it as early as 1830, and the Russian Government is giving attention to the subject. Prince Vassiltchikoff, of the government of Saratov, having observed that the sources of a river on his estate shrunk as the region in which they were situated was dried, planted trees, and succeeded in causing the water to reappear. The experiment seemed to demonstrate incontestably that the removal of the woods was the immediate cause of the disappearance of the springs, and indicated that means might still be found for restoring the dried streams of the valley of the Volga. M. Vermoleff, present Minister of Agriculture of Russia, repeated M. Vassiltchikoff's experiments on a vast scale and with all the precautions to assure success which science could suggest. He dispatched a scientific expedition, composed of specialists, to visit the sources of the Volga and its affluents; and upon their recommendation suitable measures were taken to increase the quantity of water of the sources, and especially to make the flow more regular and less rapid. Thus, after having drained the marshes in some of the governments of Russia, the authorities are seeking means to give others a sufficiency of water.

Mr. Maxim's Flight.—Mr. Maxim, on the 31st of July, achieved a flight through the air, with his flying machine carrying himself and two of his men, of five hundred feet. The machine was held to the earth by a railway, on which it was locked by a device permitting its rising an inch or two, but preventing its soaring to any considerable height. It sailed, lifted from this railway as far as the machinery would permit, at the rate of forty-five miles an hour. The machine, with its four side-sails and aëroplanes set, is more than one hundred feet wide, and is described as looking like a huge white bird with four wings instead of two. It is propelled by two large two-bladed screws, resembling the screw propellers of a ship, driven by two compound engines which are said to be, in proportion to their weight, the most powerful ever made. The whole apparatus weighs about eight thousand pounds, and the engines have a lifting power of about ten thousand pounds.

Progress of Electrical Theory.—Lord Kelvin's address at the recent annual meeting of the Royal Society was largely devoted to a review of the history of the doctrine of the ether, and of light, heat, and electricity, culminating in Hertz's demonstration of its validity. During the fifty-six years, the speaker said at the conclusion of his address, since Faraday first offended physical mathematicians with his curved lines of

force, many workers and many thinkers have helped to build up the nineteenth-century school of *plenum*—one ether for light, heat, electricity, magnetism; and the German and English volumes containing Hertz's electrical papers, given to the world in the last decade of the century, will be a splendid monument of the consummation now realized. The Royal Society's Transactions and Proceedings of the last forty years contain, in the communications of Gassiot, Andrews and Tait, Cromwell, Varley, De la Rue and Müller, Spottiswoode, Moulton, Plücker, Crookes, Grove, Robinson, Schuster, J. J. Thomson, and Fleming, almost a complete history of the new province of electrical science, which has grown up largely in virtue of the great modern improvements in practical methods for exhausting air from glass vessels, by which we now have "vacuum tubes" and bulbs containing less than $\frac{1}{190000}$ of the air which would be left in them by all that could be done in the way of exhausting (supposed to be down to one millimetre of mercury) by the best air-pump of fifty years ago. A large part of the fresh discoveries in this province have been made by the authors of these communications, and their references to the discoveries of other workers very nearly complete the history of all that has been done in the way of investigating the transmission of electricity through highly rarefied air and gases since the time of Faraday.

Paleontological Riches of Texas.—In his report to the State Geological Survey on the Invertebrate Paleontology of the Texas Cretaceous, F. W. Cragin characterized the State as a mine of paleontological research, particularly with respect to the extensive and as yet little known faunæ of its Comanche series. The work of the recently deceased Dr. Roemer, the little illustrated but mainly accurate paleontological work of Dr. Shumard, the work of Conrad upon the collections made by the Mexican Boundary Survey, not to mention numerous lesser contributions by Marcou, White, Hill, Giebel Schlueter, and others, all taken together, have only tapped this great mine of knowledge. And this, as regards invertebrate forms alone; for the vertebrates of the Texas Cretaceous, and particularly those vertebrate faunæ which are of the greatest importance as factors of the stratigraphic and taxonomic problems of the lower rocks of the Comanche series, are almost wholly unknown. Of the remains of Cretaceous invertebrate organisms a great wealth of material has been accumulated by the survey, including types of many new forms of exact biological and stratigraphical significance.

Manganese in Alabama.—A report on the geological structure of Murphree's Valley, Alabama, made to the State Geologist by Assistant A. M. Gibson, shows that besides limestone and hematite and limonite iron ores, the estimates of the value of which have been confirmed in the working, it contains manganese ores and beds of fine clays. Half a dozen or more spots are described, all in the same region, where deposits of manganese ores, chiefly pyrolusite, of good quality, have been seen. The discoveries of these deposits have been in the main accidental, and they cover only a very small part of the ground where ores are presumed to exist. It is therefore probable that the larger proportion of the beds still remain undiscovered. The clays comprise brick clays and halloysite or porcelain clay—a similar bed to which has been worked with satisfactory results in De Kalb County—along with which are a honestone grit, sandstones, and honestones suitable for building, and a fireproof conglomerate. Besides two lines of exposure of iron ores and one of carboniferous limestone, this valley is favored with "ample coal accessible on both sides at its very edge."

Arago's Work.—In his address at the unveiling of a statue of Arago, in Paris, June 11th, M. Tisserand said that "Arago introduced physics into astronomy, and gave it a permanent place. Before him, astronomers concerned themselves chiefly with the movements of the stars and the members of our planetary system, seeking to explain them in their minutest details by the law of gravitation. Arago studied the nature of the heavenly bodies, and the character of the phenomena continually exhibited by them. The polariscope showed him that the glaring surface of the sun is gaseous, and gave him important information as to the light of comets. Another application of physical methods furnished him with a pre-

cise means for measuring the diameters of planets or determining their magnitude. Nothing is more ingenious than his explanation of the scintillation of stars, based upon the remarkable properties Fresnel found to be possessed by rays of light. Arago ought truly to be considered as the founder of a branch of astronomy—physical astronomy—that has since been remarkably extended, for it was he who pointed out the importance that would accrue from the application of photography to the study of celestial bodies. He was not able to see the day, however, when chemistry would enter into the domain of astronomy, and we should be able to discover their constitution; spectrum analysis has been discovered, in fact, only since the death of Arago." Arago is besides credited with having conceived the idea of drawing a unit of measurement from the light rays—an idea which has been realized by Mr. Michelson, of the American Bureau of Weights and Measures.

Value of the Nasal Index.—In Mr. H. H. Risley's examination of the characteristics of the natives of northern India, the nose, instead of being vaguely described as broad or narrow, is accurately measured, and the proportion of the greatest width to the greatest length (from above downward), or the "nasal index" (which must not be confounded with the nasal index as defined by Broca upon the skull), gives a figure by which the main elements of the composition of this feature in any individual may be accurately described. The average of mean nasal indices of a large number of individuals of any race, tribe, or caste offers means of comparison which bring out most interesting results. By this character alone the Dravidian tribes of India are easily separable from the Aryan. Even more striking is the curiously close correspondence between the gradations of racial type exhibited by the nasal index and certain of the social data ascertained by independent inquiry.

Public Reservations in Massachusetts.—The Trustees of Public Reservations of Massachusetts received no new trusts during 1893, but they are able to record two movements instituted by the State Legislature, at their suggestion, for the better conservation of certain scenery. A bill was passed providing for the acquisition by the people of Provincetown of all the occupied parts of the province lands at the extremity of Cape Cod, and the permanent reservation of all the remaining portion (about two thousand acres) in the charge of the State Commissioners of Harbors and Lands. Another act creates a permanent Metropolitan Park Commission, with the power of eminent domain and authority to spend one million dollars in buying lands, as well as to accept gifts of land or of money to buy them with, lying within the metropolitan district. This commission has already received twelve thousand five hundred dollars from Mrs. Elish Atkins and her son toward the purchase of the "Beaver Brook reservation," in which are included Beaver Brook Falls, celebrated by Lowell in one of his early poems, and the famous "Great Oaks," which the board of trustees had failed to acquire for want of the power of eminent domain.

Importance of Ocean Currents.—The very bulk of the ocean, Captain W. J. L. Wharton remarks, in his geographical address before the British Association, as compared with that of the visible land, gives it an importance possessed by no other feature on the surface of our planet. Mr. John Murray has shown that its cubical extent is probably about fourteen times that of the dry land. The most obvious feature of the ocean is the constant horizontal movement of its surface waters. It may now be safely held that the prime motor of the surface currents is the wind—not the wind that may blow, and even persistently blow, over the portion of water that is moving, more or less rapidly, in any one direction, but the great winds that blow predominently from some general quarter over vast areas. These, combined with deflections from the land, settle the main surface circulation. The trade winds are the prime motors. They cause a surface drift of no great velocity over large areas in the same general direction as that in which they blow. The westerly winds that prevail in higher northern and southern latitudes are next in order in producing great currents. From the shape of the land they in some cases

take up and continue the circulation commenced by the trade winds; in others they originate extensive movements of the water. Compared with the great circulation from this source the effect of differences of temperature or of specific gravity is insignificant, though no doubt these play their part, especially in causing slow under circulations, and in a larger degree the vertical mixing of the lower waters.

Progress in Indexing Chemical Literature.—The Committee of the American Association on Indexing Chemical Literature reports the printing during the past year of A. C. Langmuir's Index to the Literature of Didymium, and the second volume of Mr. Trimble's Bibliography of the Tannins. Reports have been received by the committee of progress from several chemists on other works in this line upon which they are engaged. While the annual reports of this committee are properly confined to the productions of Americans, attention is directed to indications of a growing appreciation of the value of special bibliographies on the part of European chemists, confirming by their recent and proposed activities the work begun in America at Prof. Bolton's suggestion more than twelve years ago. The bibliographical work is extending to other branches of science. The International Conference of Geologists at Washington appointed a committee to prepare a list of the geologic bibliographies now in existence. A committee of the Torrey Botanical Club is publishing an index to recent literature relating to American botany. The Smithsonian Institution is publishing a series of bibliographies of aboriginal languages.

Secular Magnetic Changes.—In discussing the problems and conclusions suggested by the Magnetic Survey of the United Kingdom, Prof. A. W. Rücker observed that the question of the cause of the magnetic variations in the earth has entered upon a new stage. It has long been recognized that the earth is not a simple magnet, but that there are in each hemisphere one pole or point at which the dip needle is vertical, and two foci of maximum intensity. A comparison of earlier with later magnetic observations leads to the conclusion that one or both of the foci in each hemisphere is in motion, and that to this motion the secular change in the values of the magnetic elements is due. The observed changes can not be explained by any simple theory of a rotating or oscillating pair of poles; they suggest that secular change is due to waxing and waning of forces apparently exerted by secondary lines or points of attraction or repulsion. New facts lead us to look upon the earth not as magnetically inert, but as itself—at the equator as well as at the poles—producing or profoundly modifying the influences which give rise to secular change. And then, when we push our inquiry further, experience tells the same tale. The earth seems, as it were, alive with magnetic forces, be they due to electric currents or to variations in the state of magnetized matter. We need not now consider the sudden jerks that disturb the diurnal sweeps of the magnet, which are simultaneous at places far apart, and probably originate in causes outside our globe. But the slower secular change, of which the small part that has been observed has taken centuries to accomplish, is apparently also interfered with by some still slower agency, the action of which is confined within narrow limits of space.

The Weather Crop Service.—According to Major H. H. C. Dunwoody, of the National Weather Service, the weather crop service of the national bureau ranks next in importance to the work of making forecasts. The system of gathering reports upon which the weather crop bulletins are based has been greatly perfected in recent years. The crop bulletins of the States have been improved, and are now more complete than at any previous time, and the increased circulation that these bulletins have attained amply attests their value. It is believed that there is no other class of information to which so much space is devoted in the public press to-day. A file of these bulletins for all the States for a year will form the most complete history of the weather conditions attending the growth and development of the several crops throughout the country. More than ten thousand crop correspondents are to-day co-operating with the National Weather Service through the State organi-

zations; three thousand voluntary observers are furnishing monthly reports of daily observations of temperature and rainfall; and over eleven thousand persons assist in the work of distributing the weather forecasts of the National Weather Service. This latter work has been more rapidly pushed during the past year than any other feature of State Weather Service work. With the continuation of the present liberal policy toward these services there will be in a comparatively short time no important agricultural community in the United States, with the proper mail facilities, that will not receive the benefits of the forecasts.

The Nature of Scientific Truth.—The evidence, and the only evidence, to which science appeals or which it admits, said Dr. Brinton in his presidential address before the American Association, is that which it is in the power of every one to judge, that which is furnished directly by the senses. It deals with the actual world about us, its objective realities and present activities, and does not relegate the inquirer to dusty precedents or the moldy maxims of commentators. The only conditions that it enjoins are that the imperfections of the senses shall be corrected as far as possible, and that their observations shall be interpreted by the laws of logical induction. Its aims are distinctly beneficent. Its spirit is that of charity and human kindness. From its peaceful victories it returns laden with richer spoils than ever did warrior of old. Through its discoveries the hungry are fed and the naked are clothed by an improved agriculture and an increased food supply; the dark hours are deprived of their gloom through methods of ampler illumination; man is brought into friendly contact with man through means of rapid transportation; sickness is diminished and pain relieved by the conquests of chemistry and biology; the winter wind is shorn of its sharpness by the geologist's discovery of a mineral fuel; and so on, in a thousand ways, the comfort of our daily lives and the pleasurable employment of our faculties are increased by the administrations of science. Scientific truth has likewise this trait of its own—it is absolutely open to the world; it is as free as air, as visible as light. There is no such thing about it as an inner secret, a mysterious gnosis, shared by the favored few, the select illuminati, concealed from the vulgar horde, or masked to them under ambiguous terms. Wherever you find mystery, concealment, occultism, you may be sure that the spirit of science does not dwell, and, what is more, that it would be an unwelcome intruder. Such pretensions belong to pseudo-science, to science falsely so called, shutting itself out of the light because it is afraid of the light.

A Lesson concerning Epidemics.—An epidemic of typhoid fever which prevailed in Buffalo, N. Y., in March, 1894, is the subject of a contribution by Prof. S. A. Lattimore to the Rochester Academy of Science. A noteworthy feature of the pestilence is that it prevailed in those parts of the city that draw from the water supply, while those parts to which the supply system had not extended and depended on wells were exempt from it. The source of the disease was therefore looked for in the water supply. This is pumped from the Niagara River at such a distance from the shore as is supposed to make sure against contamination by sewage. There is, however, a secondary inlet which sewage may reach, but which is usually closed. During the latter part of February the winds blew in such a way as to force the water of the river back, making it so low at the pumping station that the quantity entering the tunnel was not sufficient for the maintenance of an adequate pressure. The secondary inlet was opened, and the fever began. Upon analysis of the water the typhoid bacillus was found in it. The exclusive supply from the crib in the middle of the river was resumed, the reservoir and pipes were washed out and disinfected, and the epidemic ceased. Prof. Lattimore draws from the incident a forcible lesson on the necessity of avoiding the pollution of lakes and rivers on which cities and districts may be dependent for supplies. "Has a city," he asks, "any more right than a private citizen to render itself a nuisance by discharging its waste upon their [its neighbors'] property, and rendering odious, if not dangerous, the air they must breathe and the water they must drink? Is it a premature question to ask if the time has not almost come when

cities shall no longer convert the natural waterways into sewers, and the lakes into reservoirs for their sewage? Methods of sewage disposal and disinfection have been already so far perfected that, in my opinion, at no distant day, compulsory destruction of all offensive and dangerous waste material, of whatsoever kind, may be legally enforced without serious expense or inconvenience. Again, are we quite rational in the relative estimate we place upon our most cherished possessions? Do we not strangely, insanely underrate health and life, and overrate greatly the mere things which possess absolutely no value at all apart from life and health?" These conclusions are strikingly enforced in the lesson of the recent outbreak of typhoid fever at Wesleyan University, that has been traced to the eating of oysters raw which had been exposed to contamination in their temporary storage bed by a drain leading from a house where there was typhoid fever.

The Peopling of America.—In trying to account for the settlement of America by spontaneous migrations, Prof. O. T. Mason postulates that the emigrants would be drawn, in the quest for food, along the lines of most abundant supply and of least resistance. He accepts Morgan's location of the region about the mouth of the Columbia River as the starting point of the migration over the continent. Whence and how did men come to that point? He finds a route from Asia to America that might have been nearly all the way by sea, and continuously used for centuries; and which lies absolutely along a great circle of the earth, the shortest and easiest highway. This great circle route lies mostly through landlocked waters, and embraces, in order, the northeastern Indo-Malayan Archipelago, the South China and Malay Seas, the East China and Yellow Seas, the Japanese and Tartary Seas, the Okhotsk Sea and environs, the Bering Sea with its bays, the Alaskan Sea and inlets, the Tlinget-Haide Sea, the Vancouver Sea, and the Columbia Basin. The same great circle would go on to include the head waters of all the Rocky Mountain streams, the great interior basin, the Pueblo region, Mexico, Central America, Ecuador, and Peru. Along it food is abundant, no point is at a very great distance from land, and all the conditions are as favorable as could be found anywhere to the success of a voyager. Hence Prof. Mason advances the hypothesis that during the centuries in which Europe was working out of its earliest stone age into its renascence, certainly for three thousand years or more, America was being steadily and continuously peopled from Asia by way of its eastern shores and seas from the Indian Ocean. Subsidiary movements in the way of offshoots from this migration, contributions to it, and barriers to its progress took place up and down the rivers and in the seas of India, China, Mongolia, and Siberia. The author disclaims any reliance upon theories of sunken continents, upon voyages across the profound sea without food or motive, the accidental stranding of junks, or the aimless wandering of lost tribes; assumes that there never was known to history a day when the Asiatic and American continents were not intimately associated; and concludes that "when the continent of America was peopled it was done by men and women purposely engaged in what all sensible people are now doing—namely, trying to get all the enjoyment possible out of life for their efforts."

The Critical Faculty in Engineering.—The presidential address of Prof. A. B. W. Kennedy, of the Section of Mechanical Science, in the British Association, was devoted to the critical side of mechanical training—the training to think about a subject, to write upon it, and to come to a rational decision, by exercising a critical sense of proportion which could be best developed by a course of quantitative experimental work in an engineering laboratory. After observing that an engineer was a man who was continually called upon to make up his mind irrevocably in a very short time—generally about one tenth of the time which he would like to give to the subject—the author pointed out that there was an essential difference between the problems of the mathematician and those of the engineer. In pure science and mathematics there was little room for the critical faculty—the result was either right or wrong. In engineering there might be many solutions, and the critical faculty must be rapidly supplied to the prob-

lems, their statement, their condition, and all the possible solutions. The literary faculty, the power of expression, was also of great importance, as it necessitated clear thinking and a grasp of the environment of the question, with a due sense of the proportion of its component parts, and of the forces affecting it.

Arabs of the Hadramaut.—Mr. Theodore Bent read a paper in the British Association on the Natives of the Hadramaut in South Arabia. He began by giving a brief sketch of the ancient history of this valley in the interior of Arabia, and showed how it was the great center from which frankincense and myrrh were exported to Europe by caravan routes across the desert, particulars concerning which are given us by Ptolemy and Pliny. He then went on to describe the modern inhabitants of this district, showing how the Bedouins here were, distinct from those of northern Arabia, and in all probability formed an aboriginal race, with curious customs and a religion of their own. He then spoke of the extreme fanaticism of the Arabs in the Hadramaut, a fanaticism fostered by the Sayyids and Sherifs, who claim direct descent from Mohammed and form a sort of hierarchical nobility in the country, and who have hitherto succeeded in keeping foreigners out of their territory. The Arabs not of this noble family could not intermarry with them. The Sayyids never engaged in commerce or industry, but the other Arabs were very commercial, and frequently made fortunes in India and the Straits Settlements. Mr. Bent gave a minute account of the men and women of the Hadramaut and their peculiar customs and dress, stating that he hoped to return again next winter to continue his researches.

Economics as a Branch of Education.—It is highly desirable, said Prof. C. F. Bastable, in his British Association address, that certain professions—law, journalism, and public administration may be mentioned—should have economics as a part of the training necessary for their exercise. To accomplish this object, its combination with jurisprudence, political and administrative science in a common group seems the best way. The strictly professional students would obtain a better and more suitable training, and it might be reasonably expected that some with genuinely scientific tastes would be ready to take up social science as a regular pursuit and contribute to its progress. But it is in dealing with the practical problems that this wider mode of treatment is most essential. Is it not true that commercial policy must largely depend on political and legal conditions? Even in carrying out the thoroughly wise and sound principle of free trade, the British Government finds itself involved in many curious complications. Treaties and administrative regulations have to be taken into account. The political forces that guide the tariff policies of nations have their decided effects; and whether we desire merely to estimate the actual character of any particular policy, to form a rational forecast of the course that nations will take in the future, or to give advice as to what should be done, we can not limit ourselves to abstract economic theory, or even to economic considerations. This is equally true of the currency question. The weightiest arguments for and against bimetallism are political rather than economic while such social influences as habit and custom powerfully affect the possibilities of action that purely deductive reasoning from economic premises might appear to suggest.

The Insane Kings of the Bible.—In a paper on the Insane Kings of the Bible, Dr. D. R. Burrell publishes a study of the cases of Saul and Nebuchadnezzar, in the light of modern science. Of Saul's case he finds that "his insanity was recognized, but, at a time when secondary causes were ignored, it was called 'an evil spirit from the Lord.' Judged in the light of the present, it was but the natural outcome of his character, a character made up of unstable elements easily and unfavorably affected by attending circumstances. In justice to him, it should be remembered that he was merely a herdsman's son, upon whom were thrust royal dignity, authority, and responsibility, without precedent or guide, for he was 'the first king in Israel.'" Nebuchadnezzar's insanity may have been caused partly by overwork. His treatment, in view of the sacredness of his person, his delusions, the climate and the private parks of Babylon, and the ideas of

nudity, was of the best. "It challenges our treatment of to-day, for it gave out-of-door life without stint, permitted the greatest activity, and employed neither mechanical, chemical, nor manual restraint. . . . Nothing could be truer to Nature and the daily manifestations of the insane than the account of the recovery of the king; the coming out of chaos or self-absorption; the looking upon things about him and seeing them gradually assume their correct proportions; the return of the understanding; the full return of reason; and then a heart overflowing with thankfulness, thankfulness that only those feel who have walked long in the valley of the shadow of death. If we take this chapter from the sacred canon, and study it with some knowledge of the far-off past, and in the light of insanity as manifested to us to-day, we shall discover that it is one of the most beautiful and concise descriptions of the premonition, the onset, the course, and the termination of a case of insanity that is recorded in any language."

Aluminum Violins.—Describing the aluminum violins before the American Association, Mr. Alfred Springer said that the sound-boards from that metal are analogous to those made of wood, and differ from the sound-boards made from other metals. They are analogous to wood, because they do not produce secondary tones that are not in harmony with the prime tones. Such secondary tones are found largest in elastic metals of fine uniform consistence, because the mass of such metals gives them a tendency to continue in any particular state of motion. The author had found that his experience with aluminum during the past three years was attended with many difficulties. For instance, he could find no satisfactory solder with which to fasten the plates, and was obliged to resort to rivets. In order to overcome the essential condition of uneven thicknesses of belly and back he was obliged to resort to sheet metal, ribbed and arched, and he found that in the aluminum instruments there were not the uncertainty and lack of individuality to be observed in those manufactured of wood. The wooden ones, however, were superior, and the reason the old wooden instruments were better than new ones was not in the elasticity of the wood or the composition of the varnish, but in the peculiar warping of the wood to a higher arch. He never saw a good old instrument that was not warped. Immediately after the lecture an aluminum violin was produced and played on. The tones were very full and resonant.

NOTES.

We owe our readers an apology for the absence of the illustration from the article on Pithecoid Man, printed in the December Monthly. The writer of the article sent a photograph with his manuscript from Germany, and after the number was printed we discovered that the picture had been copyrighted in this country. The owner of the copyright refusing to permit us to publish the illustration on any terms, we were obliged to throw it out, and through an oversight the needed correction was not made on the cover of the magazine.

The importance of forestry is urged by Prof. W. T. Thiselton Dyer on account of the probability that the supply of timber may be exhausted before that of coal. It further appears in view of our complete dependence upon the products of the vegetable kingdom for the necessaries of our existence.

Five genera of mammals living in the south of France are named by M. Mingaud to the Scientific Society of Nimes as nearly extinct. They are the wolf, the genet, the beaver, and the thoroughbred horses and cattle of Camargue; the last two species being in course of breeding out by crossing. The author considers it important that the natural history museums provide their collections with typical specimens of these animals.

The programme of the winter's lectures of the Franklin Institute, Philadelphia, for the season now beginning, promises a lecture on every Friday evening from November 2d to April 5th. The subjects are various, and the lecturers are masters of them. They include illustrations of travel, bacteriology, the coal mine, the photochromatoscope, watch manufacture, the relation of forests to the surface of the country, the metallurgy of aluminum, electricity and its applications to different arts, the mineral resources of the United States, sanitary engineering, and other topics.

M. Forel recently showed the Scientific Society of Lausanne some curious balls of animal hair which had been agglomerated by the waves, and were scattered over the beach of the Gulf of Morges, near the great tanneries. In some places these balls are numerous enough to form a continuous stra-

tum under the ground. If these products of the activity of the lake were buried under the soil, they might produce very singular fossils, which would be puzzling enough to geologists of the future.

CERTAIN school studies are described by Superintendent H. P. Emerson, of Buffalo, in a paper read before the Thirty-second University Convocation, as those which are of least educational value, but are yet necessary because they are the tools for acquiring further knowledge, such as reading, spelling, writing, drawing, and the most of number work or arithmetic. Here children learn the signs or symbols of knowledge rather than knowledge itself. One of the great mistakes of education in the past has been that these vehicles of knowledge have been so exalted as to occupy the most important place and to be regarded as ends in themselves.

IN a paper on Corean Children's Games, read in the American Association, Mr. Stewart Curlin said the Corean games agreed in general with the children's games in modern use, but more closely with those of the neighboring countries of China and Japan. Although they have departed somewhat from the dramatic and divinistic forms to which they can ultimately be traced, yet these early sacred associations are more apparent in them than in the children's games of other countries of eastern Asia. Toys are looked upon as sacred things. Mr. Culin spoke of the common Corean games, such as the "tug of war," in which villagers oppose villagers at either end of a rope of straw, the archery contest, the game with slaves, and others. The Chinese names of a large portion of the children's games indicate their Chinese origin. Respect for literature and the written character is seen in the literary amusements, something like the familiar word-games in America. The hatred of Japan and the Japanese which permeates Corea is well illustrated by the simple game of "fighting violets," which the children call "*o-ran ka got*"—i. e., "barbarian head-cutting."

A "Deseret professorship of Geology" has been established in Salt Lake City, Utah, endowed with sixty thousand dollars by Salt Lake City, and Dr. J. K. Talmage has been chosen and installed professor in it. The university, although not technically its owner, will enjoy the advantages of the Deseret Museum of the Academy.

PROF. BÜCHNER has shown in a series of experiments that the direct rays of the sun act efficiently in destroying microbes in small quantities of water, and that diffused sunlight also has no insignificant power in the matter. The experiments made to determine the depth to which this action of sunlight penetrates showed that it diminishes very fast between a metre and a half and two metres and a half, at which depth it is hardly perceptible. From this result, Prof. G. C. Frankland infers that the influence of light in purifying water (that is, large bodies) can not be regarded as of much importance; and it would hardly be safe to depend on its operation in the "self-purification" of rivers. Other experiments indicate that microbes thrive in the dark and multiply in the night, under favorable conditions of temperature.

A MONUMENT to Quatrefages was unveiled at Valleraugues, France, August 20th, in the presence of a deputation of the most eminent scientific men of the country. The scientific career of Quatrefages was described in the addresses of MM. Milne-Edwards, Hamy, Geoffroy Saint-Hilaire, and Brongniart, of whom M. Hamy declared him 'the creator of anthropology. The monument consists of a bust in bronze of Quatrefages, placed upon a pedestal of stone, on the principal face of which is the statue of a young native of the Cevennes presenting a crown to the eminent naturalist.

ATTENTION is called by the English Dr. Welply to a danger which has so far escaped public notice. Creameries receive their milk from a number of farms. After the cream has been removed, some of the skim milk is sent back to the farms for consumption. The milk being all mixed together, a means is thus afforded for conveying typhoid fever or other disease existing on one of the farms to all the others, and for creating fresh disease centers. An instance where this really occurred is cited by the author. This affords a fresh argument for always boiling milk before using.

A NEW style of bottle for poisons is figured in the Lancet. It has the neck on one side, and is otherwise described as of such a shape that it will not stand up, and should always be lying down in such a position that the word "poison" and the label shall be in view; "and this peculiarity is as readily to be distinguished in the dark as in the light. A particular grip is necessary in handling it, for the fingers have to touch the table when lifting it. The peculiarity of the neck can not be overlooked when corking or uncorking." It is as cheap as an ordinary bottle.

THE work of preserving the White Mountain forests has made some progress in spite of selfish legislation. One step forward has been the designation of the Appalachian Club as a trustee to receive funds for the purchase of forest lands.

ACCORDING to the German journal *Die Natur*, a German chemist has discovered a substance possessing the singular properties of solidifying under the influence of heat and becoming liquid at temperatures below the freezing point of water. It is obtained by mixing equal parts of phenol, camphor, and saponine, with a very small quantity of turpentine, and has been named *cryostaz*, or

in English *cryostace*. This is the first substance known having the properties described; for, although albumen solidifies at a high temperature, it can never again be restored to the liquid condition.

THE Board of Regents of the University of California have decided to establish a course of anthropology at that institution.

EXTRACTS from various authorities are quoted in a paper by H. H. Clayton to show that there has been a gradual evolution in the definitions of clouds since Howard. Thus a distinction has been established between high and low cirro-stratus and high and low cirro-cumulus. The stratus has been separated into fog and low sheet clouds, and two distinct forms of rain cloud have been recognized. The author agrees that ten terms, all compounded of Howard's four fundamental types, would fully meet the requirements of practical meteorology.

DR. KARL GROSSMAN and Dr. Cahnheim in their journey across Iceland (1893), visited the lava cavern Surtshellir. They explored this cavern and photographed by means of magnesium light the wonderful ice cave which exists in its farthest recess. On their return journey they made a second descent, with a view of searching for the coins deposited there by previous travelers. Successful in their efforts, they took two of the oldest coins, after leaving new ones in their places. It was their intention to restore the old coins to their former resting place on the occasion of their next visit.

AN important work now in hand, under the auspices of the Anthropological Section of the British Association, is the organization of an ethnographical survey of the United Kingdom, based upon scientific principles. It is proposed to record in a systematic and uniform character for certain typical villages and the neighboring districts: 1, The physical types of the inhabitants; 2, their current traditions and beliefs; 3, peculiarities of dialect; 4, monumental and other remains of ancient culture; and, 5, historical evidence as to continuity of race.

OBITUARY NOTES.

COLONEL GARRICK MALLERY, of the United States Army, retired, an esteemed contributor to The Popular Science Monthly, died in Washington, October 24th, aged sixty-three years. He was born at Wilkesbarre, Pa., and was educated at Yale. In 1861 he entered the volunteer service, and for gallantry in action was promoted four times, finally rising to the rank of lieutenant-colonel. He was one of the Libby prisoners. He was in charge of the Signal-Service Bureau from 1870 to 1876, and then was ordered to Dakota. His investigations into Indian sign and gesture language, concerning which he published valuable papers in the Smithsonian series and in scientific journals, gave him a high scientific reputation. He was President of the Cosmos Club of Washington.

DR. TERRIEN DE LACOUPERIE, at one time Professor of the Comparative Philology of Southeastern Asia at University College, died in Fulham, England, October 11th. To him belongs the credit of having determined the origin of the Chinese writing and early civilization. He was of Norman descent and began life as a merchant, but was drawn away to science and particularly to comparative philology. Having studied the early writing of China, he compared it with the cuneiform characters of Babylonia, and found evidence that some of the characters had been borrowed from the ancient Akkadian. Tracing out other affinities, he found a like correspondence between the civilization of the Chinese and those of Elam and Chaldea. He discovered the key to the puzzling Yih-king, or Book of Changes, of the Chinese, determining that it consists of old fragments of early times in China, mostly of a lexical character. He was author of the books: The Early History of Chinese Civilization, The Languages of China before the Chinese, A Catalogue of Chinese Coins from the Seventh Century B. C. to A. D. 621, and The Western Origin of the Early Chinese Civilization, from 2300 B. C. to 200 A. D.

WILLIAM TOPLEY, F. R. S., an industrious English working geologist, died in Croydon, September 30th, of gastritis contracted during a geological visit to Algeria. He was a special student of the geology of the Weald, on various aspects of which he contributed several papers, and of the bearings of geology on other branches of knowledge. One of his papers treated of the relation of parish boundaries to great physical features. His most important work was The Geological Survey Memoir of the Weald. He was Secretary of the Geological Section of the British Association for fifteen years, was Secretary of the Committee on Coast Erosion, and was President of the Geologists' Association from 1885 to 1887. He took part in most of the international geological congresses, and was for a time a sub-editor, and afterward editor, on the Geological Record.

PROF. N. PRINGSHEIM, an eminent German botanist, died October 6th, in the seventy-second year of his age. He wrote especially on the processes of fructification and germination in the *Algæ*. He was Professor of Botany at Jena from 1864 to 1868, and founded there the first Institute for Vegetable Physiology. He returned to Berlin in the latter year, and established a private laboratory, in which he carried out valuable investigations on the sexual life of the lowest vegetable organisms.